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Development Potential for the 150 Seat New Technology Aircraft for the 1990's

Summary Report

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DEVELOPMENT POTENTIAL FOR THE 150-SEAT NEW TECHNOLOGY AIRCRAFT FOR THE 1990'S

SUMMARY REPORT

by

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Toronto, Ontario

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17. Abstract

The purpose of this study was to investigate the development and market potential of a new technology 150-passenger aircraft. The work was part of an overall evaluation program by the federal government to identify and assess Canada's opportunities for participation in the development and production of such aircraft.

The study examined the economic environment of the world aerospace industry, predicted timing of airline requirements for new aircraft, and analyzed presumed corporate objectives and strategies of airframe and engine manufacturers. The study also addressed the impact of manufacturers' marketing practices and examined the strategic gaps and product portfolio gaps of each manufacturer. From these assessments each competitor's likely share in the 150-seat market was estimated for the 1988-2002 period.

The study concluded that there is a definite need for a fuel-efficient aircraft incorporating new technology, with the proposed Airbus A320 achieving sales of 500-900 aircraft in the 1988-2002 period if development and production costs can be kept under tight control. Boeing and McDonnell-Douglas are considered unlikely to embark on the development of a totally new aircraft in the near future. Boeing will eventually build an all new 150-seat aircraft, possibly with Japanese involvement, while McDonnell-Douglas will attempt to compete with the existing DC9 Super 80 line.

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17. Résumé

Cette étude avait pour objet de cerner les possibilités de lancement sur le marché d'un avion commercial 150 places de technologie avancée, et aussi d'en déterminer les perspectives commerciales le cas échéant. L'étude entrait dans le cadre du programme lancé par le gouvernement fédéral pour reconnaître et évaluer le créneau concerné ainsi que l'intérêt pour le Canada de participer à son exploitation.

L'étude a fait un tour d'horizon des perspectives économiques de l'industrie aérospatiale mondiale, déterminé quand les compagnies aériennes renouvelleraient leur parc et sondé les objectifs et les stratégies que les avionneurs et les motoristes voudront vraisemblablement se donner à cet égard. Enfin, elle a évalué les orientations commerciales des divers constructeurs et leurs effets sur le marché, les mettant en rapport avec les créneaux que ces constructeurs voudront ou ne voudront pas éventuellement exploiter. Il en est résulté un bilan comparatif de la part du marché pouvant être occupé par les entreprises visées, à l'horizon 1988-2002.

En conclusion, il existe effectivement un créneau pour un avion à consommation améliorée et à technologie de pointe, l'Airbus A320 devant atteindre pour la période considérée un chiffre de ventes situé entre 500 et 900 exemplaires, si toutefois les coûts de développement et de production restent fermes. Il ne semble pas que Boeing et McDonnell-Douglas soient prêtes à se lancer dans cette aventure dans un avenir rapproché. Eventuellement, Boeing lancera un avion complètement nouveau dans la catégorie des 150 passagers, avec la participation possible des Japonais, tandis que McDonnell-Douglas tentera sa chance avec son DC-9 Super 80.

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1. INTRODUCTION

At the request of the Transportation Development Centre, Peat Marwick has undertaken a study of the development potential for the 150-seat new technology aircraft for the 1990's. The study is part of an overall evaluation program carried out by the federal government to identify and assess Canada's opportunities for participation in the development and production of such aircraft.

The scope of the study included:

- studying the airframe manufacturers' corporate objectives, strategies and business portfolios to assess their current and future strengths and weaknesses;

- examining the objectives and strategies of the engine manufacturers to determine if a suitable new technology engine will be available to power a new technology 150-seat aircraft;

- determining the strategic and product portfolio gaps of the major competitors and assessing their future strategic postures;

- projecting the market shares of the major competitors, including Airbus Industrie's share, for the period 1988-2002.

2. DEMAND FOR NEW 150-SEAT AIRCRAFT

Airlines require new aircraft to meet growth in air travel. Other factors also influence airline requirements for new aircraft. These factors include:

- aircraft age - many aircraft are near the end of their physical life;
- stricter noise standards - which may require some aircraft to be scrapped;
- over-capacity of twin-aisle aircraft;
- aviation fuel price rises - many older aircraft are now uneconomic, relative to newer aircraft;
- airframe manufacturer competition - airlines like to maintain at least two suppliers.

Aircraft manufacturers forecast that as many as 6,000 new aircraft will be required to meet the airline requirements for new aircraft in the period 1982-2002. Requirements for single-aisle aircraft, including the A320, represent the largest segment of the market.

2.1 Ability of Airlines to Purchase New Aircraft

The ability of airlines to purchase new aircraft is determined by profitability, or by the willingness of governments of state-owned airlines to provide financing to purchase new aircraft. World airline operating results have been extremely poor since 1979. In 1981, operating results after interest and taxes reached a loss of U.S. $1.8 billion. Airline operating results are not,

however, uniform worldwide. In our assessment, operating results before interest and taxes appear as follows:

Airline Operating Results
($ million)

	Year		
	1980	1981	1982
Europe	-455	-455	-68
North America	-227	-340	-418
Other	+47	+195	+336
World	-635	-600	-150

Source: ICAO, Air Transport World and Peat Marwick Analysis

These data show that airline operating results are now significantly better in Europe and in other parts of the world than in North America. The operating results of the major U.S. carriers have been adversely affected by deregulation in the U.S. and by the recent recession.

U.S. carriers have traditionally been the launch customers for new aircraft programs. However, these operating results make it unlikely that U.S. airlines will provide large launch orders for a new 150-passenger aircraft. Launch orders for a new 150-seat aircraft are possible from non-U.S. carriers who are currently much more profitable than U.S. carriers.

2.2 Demand for New Single-Aisle Aircraft

Smaller aircraft, such as the Boeing 737-200 or larger aircraft, such as the Boeing 757, can sometimes be substituted for a 150-seater aircraft. Because

of the potential use of various single-aisle aircraft types to meet an airline's need for 150-seater aircraft, the market shares for all single-aisle classes ("110", "150" and "200") must thus all be determined. The single-aisle classes correspond to the average seating capacity in each class.

Determining the market shares for single-aisle aircraft in the period 1988 to 2002 requires, as a basis, a forecast of future air traffic. The steps involved in forecasting requirements for new single-aisle passenger aircraft are:

a) Forecasting the demand for air travel for different areas of the world.

b) Forecasting the shares that each aircraft class will take of the future airline fleets to meet the projected air traffic in (a).

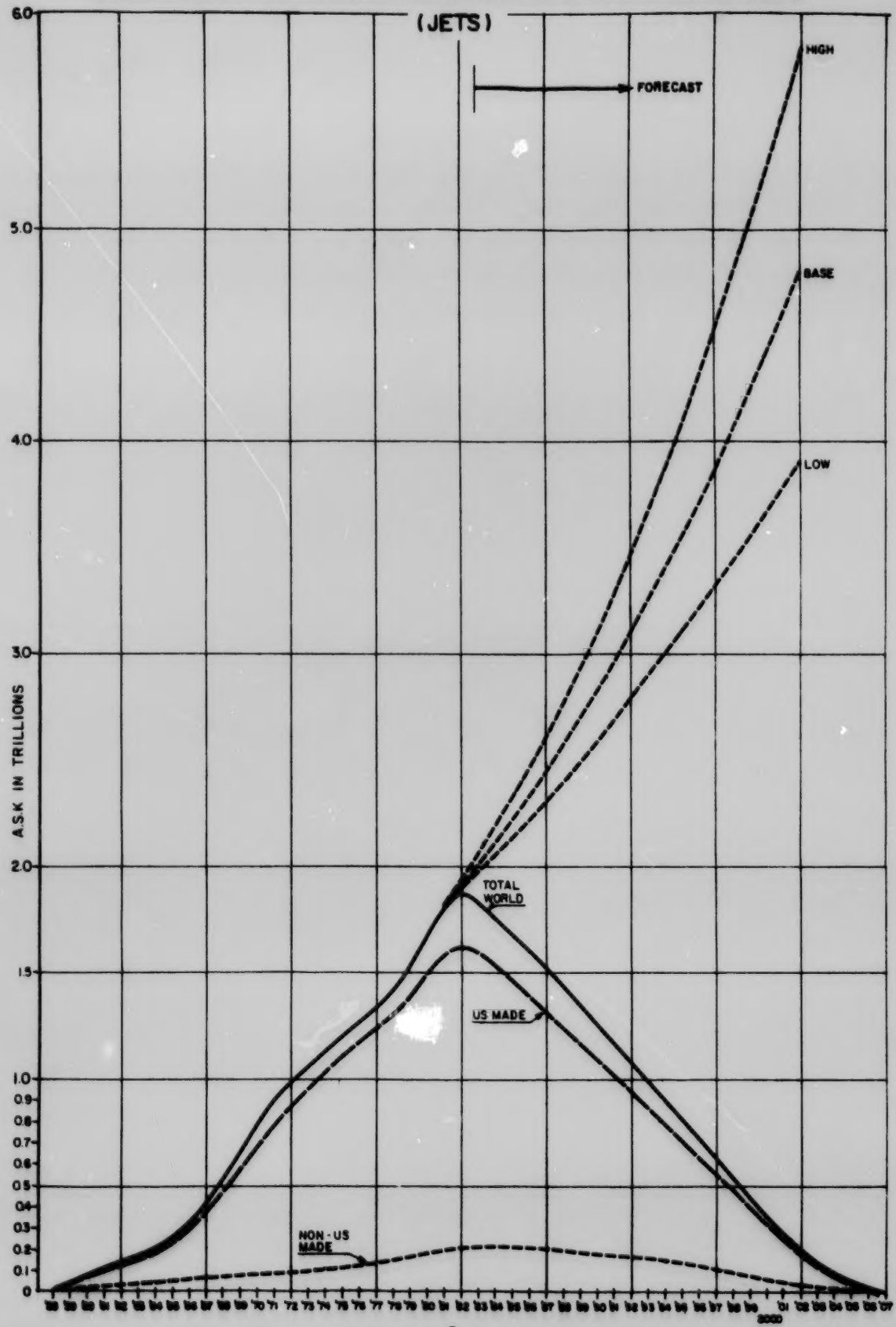
c) Forecasting the numbers of aircraft required in each class considering the numbers of aircraft presently in these classes, the projected seating capacity of aircraft in each class and the replacement of aircraft scheduled for retirement.

The requirements for new 150-seater aircraft are sensitive to the growth of air traffic. While growth in air travel (measured in revenue passenger kilometres) has averaged 10% per year in the period 1962-1983, future growth rates are now projected to be in the 4% to 7% per annum range.

A forecast of the required available seat kilometres to meet the projected growth in air travel is shown in Exhibit 1, opposite. The difference between required available seat kilometres and the available seat kilometres provided by the unretired 1982 world fleet represents the demand for seat kilometres which will be met by new aircraft purchases.

EXHIBIT 1

HISTORICAL AND PROJECTED AVAILABLE SEAT KILOMETRES



The requirements for new aircraft will be met by both single-aisle and twin-aisle aircraft. In this study, the single-aisle segment was assumed to hold the same portion of future fleets as they do now. The future fleet mixes were projected for the "110", "150" and "200" classes and result in the requirements for single-aisle aircraft shown in Exhibit 2, opposite, for the period 1988-2002.

EXHIBIT 2

REQUIREMENTS FOR NEW SINGLE-AISLE AIRCRAFT BY AREA
(BASE FORECAST)

	1988-1992	1993-1997	1998-2002	Total
North America				
"110"	618	285	145	1048
"150"	220	353	407	980
"200"	90	155	173	418
Total	928	793	725	2446
Europe				
"110"	191	51	30	272
"150"	171	216	220	607
"200"	58	90	111	259
Total	420	357	361	1138
Other				
"110"	213	88	61	362
"150"	365	310	372	1047
"200"	139	297	383	819
Total	717	695	816	2228
World				
"110"	1022	424	236	1682
"150"	756	879	999	2634
"200"	287	542	667	1469
Total	2065	1845	1902	5812

3. SUPPLY OF NEW 150-SEAT AIRCRAFT

Large commercial aircraft are supplied by three major airframe manufacturers; Airbus Industrie, Boeing and McDonnell-Douglas. The jet engines which are used to power commercial jet aircraft are supplied by Pratt and Whitney, General Electric and Rolls-Royce.

Production of jet aircraft and jet engines is a high risk business with few winners and many losers. Unique characteristics include relatively low production volumes, large swings in production rates, high development or launch costs, long lead times, a dynamic cost pattern and a uniquely difficult competitive environment.

The development costs associated with the introduction of a new jet engine or a new airframe are expected to exceed U.S. $1.5 billion ($ 1983). The peak program investment including inventories, and production tooling can be double the initial development costs. A payback in 10 years is possible for a successful program. Because of the large amount of money required for new product development and because of the limited market for new aircraft, it is thought that at most two engine manufacturers and two airframe manufacturers could profitably introduce new technology engines and airframes for the 150-seater market.

3.1 Jet Engine Manufacturers

The major jet engine manufacturers for large commercial jet aircraft are: Rolls-Royce (England); Pratt and Whitney, a division of United Technologies (U.S.A.); General Electric (U.S.A.); and CFM International, a 50/50 revenue sharing joint venture between General Electric and SNECMA (France).

Because of the joint venture and the complementary nature of the CFM product line, the CFM56 engine family has been included as part of the General Electric product line. The product lines of the engine manufacturers are classified according to thrust class. Exhibit 3, following, illustrates the product coverage of each of the engine manufacturers.

The CFM56-4 engine is currently the best engine offered to power a new 150-seat aircraft. While Pratt and Whitney and Rolls-Royce have formed a consortium to develop an advanced technology 25,000 pound thrust engine, the economics of this new engine may be unfavourable compared to the CFM56-4, depending on fuel prices. To recover development costs, an all-new technology engine is likely to cost an airline $1 million per engine more than the price of the CFM56-4 engine currently proposed for the A320. Because of this premium, airlines may consider that the return on investment of an all-new technology engine is insufficient to displace the CFM56-4. Thus, it could happen that the CFM56-4 engine might be the only engine offered to power a new 150-seat aircraft.

3.2 Airframe Manufacturers

The major competitors in the airframe manufacturing business are Boeing, McDonnell-Douglas and Airbus Industrie.

Boeing

Boeing is the largest civil aircraft manufacturer in the world, with headquarters in Seattle, U.S.A. Boeing has a broad customer base in the world market fashioned on sales of 707's, 727's, 737's, and 747's. However, Boeing's new products, the 767 and 757, are not selling well outside North America. Boeing has, so far, managed to keep Airbus out of the U.S. market except for the Airbus sale of A300's to Eastern Airlines. With McDonnell-

EXHIBIT 3

PRODUCT MIX BY THRUST CLASS

THRUST CLASS	EXAMPLES OF AIRCRAFT	ENGINE NAME		
		ROLLS ROYCE	GENERAL ELECTRIC	PRATT & WHITNEY
45,000 - 60,000 lbs.	B767, B747, A310, A300	RB 211-22B(N) -524	CF6(N)	JT9D(N) ↓ PW4000(N)
30,000 - 45,000 lbs.	B757	RB211-535C(N)	-	PW2037(N)
20,000 - 25,000 lbs.	B727, B737, DC9	-	CFM56(I)	JT8D-200(O)
10,000 - 20,000 lbs.	F28	Tay	-	-

GENERATION N = NEW
I = INTERMEDIATE
O = OLD

Source: Rolls Royce and PMP analysis

Douglas becoming a less potent threat, Boeing is fast gaining a dominant share of the U.S. market.

McDonnell-Douglas

McDonnell-Douglas is the third largest airframe manufacturer in the world, with headquarters in St. Louis, U.S.A. McDonnell-Douglas has a broad customer base for its DC9s and DC10s. Sales, however, have been declining - particularly of the DC10 which received no orders in 1982. McDonnell-Douglas, at considerable cost, has managed to stay in the commercial aviation business with several lease deals with major airlines.

Airbus Industrie

Airbus Industrie is now the second largest airframe manufacturer in the world and has its world headquarters near Toulouse, France. Airbus Industrie is a partnership of European aerospace manufacturers formed in 1979 with an objective of building commercial passenger jet aircraft. The partnership (voting) shares in Airbus Industrie are as follows:

- Aerospatiale (France) - 37.9%;
- Deutsche Airbus (a subsidiary of Messerschmitt-Boelkow-Blohm) (Germany) - 37.9%;
- British Aerospace PLC (Great Britain) - 20%;
- CASA (Spain) - 4.2%.

Airbus Industrie associate partners with no voting rights are Fokker of the Netherlands and Belairbus of Belgium.

Airbus makes major business decisions by requiring 81% of the votes cast (in proportion to partner equity position) to support the business decision. Effectively, this gives the three major partners veto power.

The Airbus Industrie customer base in the world market is fashioned on sales of the A300 and A310. Airbus managed to capture more than 50% of widebody sales world-wide in 1981 despite being virtually shut out of the U.S. market.

3.2.1 Product Line Coverage and Gaps

The current product lines of Airbus, Boeing, and McDonnell-Douglas are shown competitively according to the passenger capacity and range of each of the competitor aircraft in Exhibit 4, opposite. The forecast delivery requirements for 1982-2000 (as provided by Airbus) for each of the aircraft segments is also shown in this Exhibit.

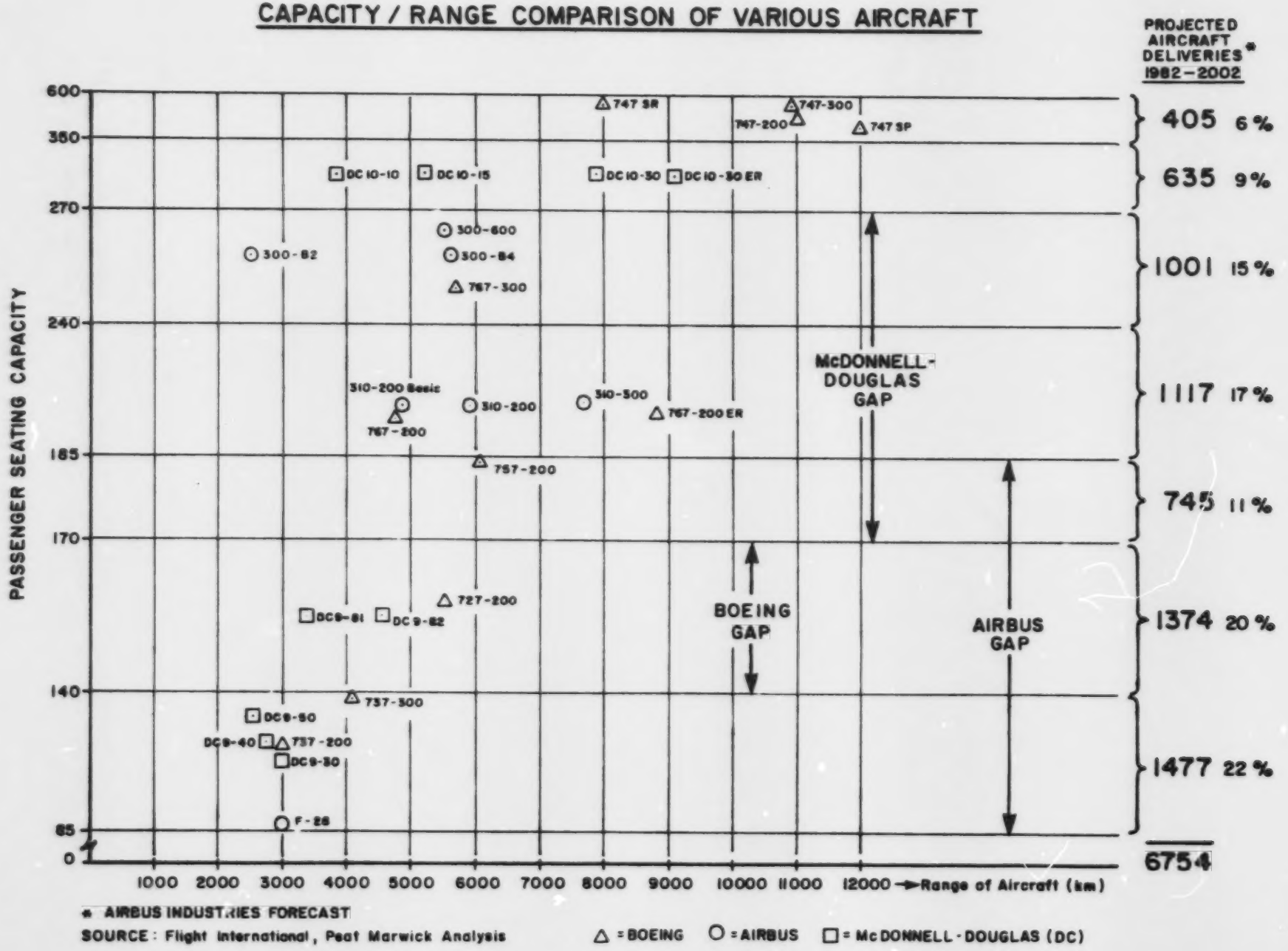
Boeing has the widest market coverage of any of the aircraft manufacturers. Boeing, nevertheless, has a gap in its market coverage caused by the discontinuation of the 727-200. Boeing hopes that its 737 (-200 and -300 versions) and the 757 will meet any requirements in the broader 100-200 seat segment and fill the Boeing gap created by the discontinuation of the 727-200.

Airbus has product line gaps for aircraft with passenger capacities less than 200 and greater than 270. The largest unfilled opportunity, the Airbus gap, is for airplanes with passenger seating capacities below 200 seats. According to Airbus, as many as 3,596 aircraft with seating capacity less than 200 will be required in the period 1982-2000.

McDonnell-Douglas has product line gaps for aircraft with passenger capacities between 170 and 270 and for aircraft with passenger capacities greater than 350. The largest unfilled opportunity, the McDonnell-Douglas gap, is for airplanes with passenger capacities between 170 and 270 which, according to

EXHIBIT 4

CAPACITY / RANGE COMPARISON OF VARIOUS AIRCRAFT



* AIRBUS INDUSTRIES FORECAST

SOURCE: Flight International, Peat Marwick Analysis

△ = BOEING ○ = AIRBUS □ = McDONNELL-DOUGLAS (DC)

the Airbus Industrie forecast, will represent 43% of the projected deliveries in the period 1982-2000.

3.2.2 Business Portfolios

The business activities of each aerospace company consist of a portfolio of businesses which are strategically separable. Each of these Strategic Business Units are distinct businesses with different missions, concepts, competitors, technologies, markets and financial requirements.

For each aerospace company, the military and civil aviation businesses face different business environments. Demand for military products is a function of the size of a country's GNP and re-equipment requirements, and thus this demand fluctuates less than the demand for civil aircraft which is a function of changes in GNP size and the profitability of airlines.

Airbus Industrie

The current business portfolio of Airbus Industrie is strictly limited to commercial jet aircraft. However, when the business activities of all the Airbus partners are included, the Airbus consortium is widely diversified. The business portfolio of the Airbus partners is currently as follows:

- civil aviation programs 27%;
- military programs 53%;
- helicopters 10%;
- space and other activities 10%.

Airbus Industrie has not yet reached a break-even point for any of its commercial jet aircraft programs. Furthermore, Airbus Industrie is believed to be losing approximately $100 million per year (based on industry sources - official data not available). The cash flow shortfall of Airbus Industrie is

probably much larger than $100 million because of expanding A300 production and the A310 introduction. Cash flows would continue to be negative because of the required investments to expand A310 production and because of development work related to the A300-600 and A310-300 derivatives. The negative cash flows arising from the Airbus Industrie program are being met through direct contributions through governments and by positive cash flows generated by the military and space businesses of each of the Airbus partners.

Boeing

Boeing has a diversified business portfolio with the highest emphasis on civil aviation programs of any of the civil aircraft companies. The current business portfolio is as follows:

- commercial transport 76%;
- military transport 13%;
- missiles and space 6%;
- other 5%.

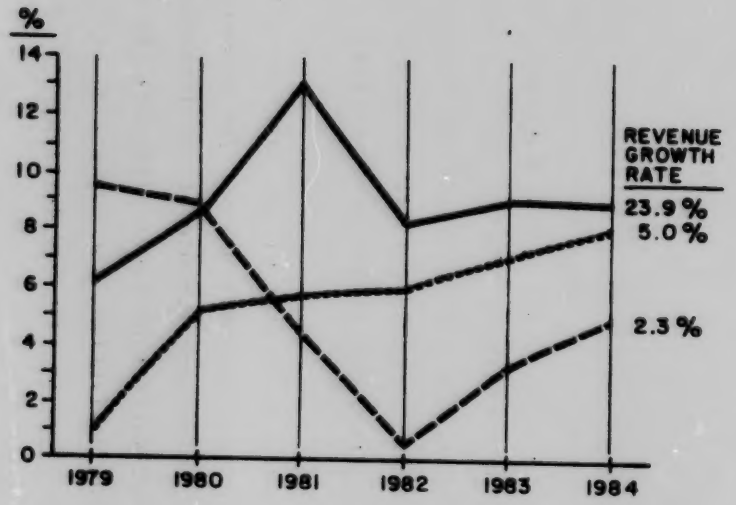
Boeing's financial performance deteriorated because of a steep drop in the profitability of the commercial aircraft business between 1980 and 1982, as seen in Exhibit 5, following. Military programs have, however, been quite profitable and are enjoying high growth rates (23.9% per year), offsetting much of the profit decline in the commercial aircraft business. The missiles and space business is also providing significant profits.

Military programs are attractive because of the large positive cash flows that they provide to other strategic business units. The commercial aircraft business unit is currently draining cash because of the introduction of new commercial aircraft and derivatives of older aircraft. Because of a downturn in both aircraft orders and deliveries, the commercial aircraft business is providing insufficient cashflow to fund new development. Because of these new

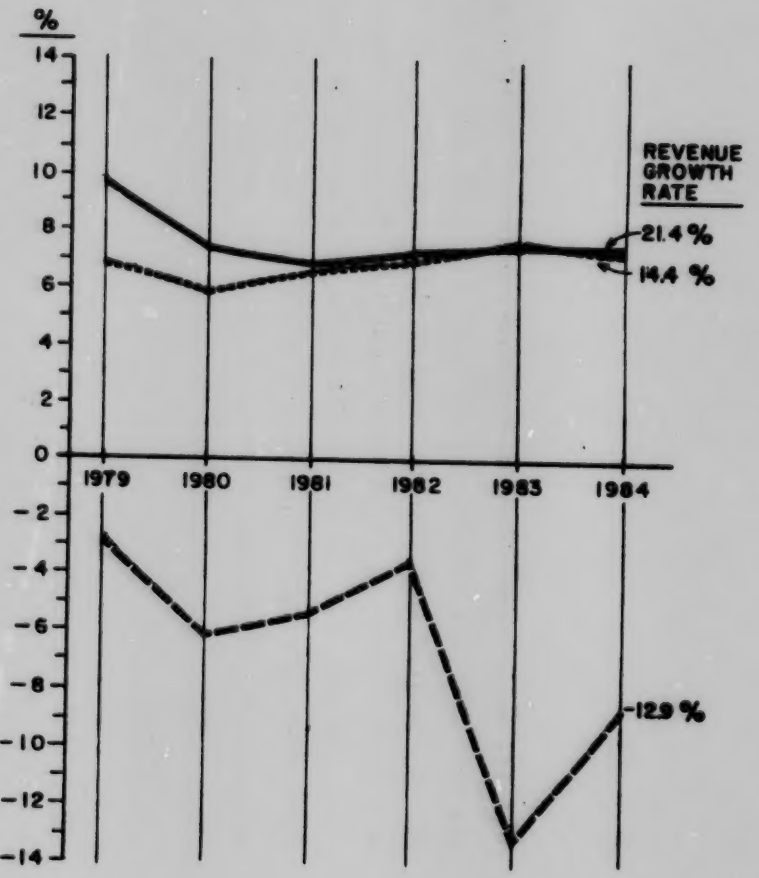
EXHIBIT 5

PROFITS AS A PERCENTAGE OF REVENUES

BOEING



McDONNELL-DOUGLAS



LEGEND

- MILITARY AIRCRAFT
- COMMERCIAL AIRCRAFT
- MISSILES & SPACE

SOURCE: Cyrus J. Lawrence, Bache Halsey Stuart, Peat Marwick Analysis

aircraft development programs, Boeing is projected to have a cash requirement of $260 million in 1983.

By 1984, the development program for the 767 and 757 should have passed their peak requirements for cash, and increased demand for military products should allow Boeing to start repaying its debt in 1984, allowing the company to improve its debt-equity ratio. The projected positive cash flows generated by all businesses should allow Boeing to rapidly increase its additional debt capacity after 1983, as shown in Exhibit 6, following.

McDonnell-Douglas

The current business portfolio of McDonnell-Douglas is diversified with a strong bias towards militry aircraft. The current McDonnell-Douglas business portfolio is as follows:

- military aircraft 47%;
- commercial aircraft 34%;
- missiles and space 13%;
- other 6%.

McDonnell-Douglas would normally have a balanced business portfolio. The military aircraft, and missiles and space businesses are both enjoying high profitability and high growth, as seen in Exhibit 5, and are providing substantial cash flows that can be invested in the other business units. However, the commercial aircraft business has been quite unprofitable and has considerable cash requirements.

It appears that the commercial aircraft business unit was faced with a harvest or divest decision. McDonnell-Douglas appears to have made a strategic decision in mid-1982 to remain in the commercial aircraft business. To do so, and in the adverse economic climate of 1982, McDonnell-Douglas entered into

EXHIBIT 6

PROJECTED FINANCIAL CAPACITY OF BOEING AND McDONNELL-DOUGLAS

McDONNELL-DOUGLAS

	1983	1984	1985	1986	1987
Borrowing Requirements	383	206	122	(96)	(156)
Additional Debt Capacity	537	462	506	807	1203

BOEING

	1983	1984	1985	1986	1987
Borrowing Requirements	260	(60)	(215)	(149)	(192)
Additional Debt Capacity	754	953	1318	1624	2022

Source: Peat Marwick Analysis

several expensive lease agreements to allow the continued production of DC9 aircraft. Consequently, the borrowing requirements of McDonnell-Douglas are expected to be substantial, reducing the company's debt capacity. The forecast cash requirements and additional debt capacity calculated using a debt-equity ratio of 50% is shown in Exhibit 6. This forecast shows that debt capacity of McDonnell-Douglas will remain low for the next three years and will probably be insufficient to develop an all-new aircraft.

3.2.3 Corporate Objectives

Airbus Industrie

The corporate objectives of Airbus Industrie put into operational reality the national objectives of the major participating European governments. The Airbus corporate objectives include the following:

- achieve, as a minimum, a 30% share of the world commercial passenger jet market;
- establish Airbus Industrie as the number 2 world producer of civil jet aircraft;
- become a full-line competitor;
- become a world leader in aircraft technology.

Boeing

The corporate objectives of Boeing can be described as follows:

- maintain Boeing as the leading world producer of civil jet aircraft;

- maintain market share at greater than 50% of the world commercial passenger jet market;

- provide full product coverage in all segments of the market;

- maintain Boeing's leading technical position;

- avoid financial risk by maintaining the company's traditionally conservative financial policies and in the short term, reduce the company's debt to equity ratio.

McDonnell-Douglas

The corporate objectives of McDonnell-Douglas include the following:

- maintain a presence in the commercial jet market for as long as possible to exploit a large single-aisle market potential;

- increase McDonnell-Douglas' share of the U.S. military business;

- diversify into other non-aviation activities such as computer services to offset future declines in U.S. government military spending;

- maintain production facilities at Long Beach, California, to ensure the survival of several military programs that depend on that facility.

3.2.4 Ability to Develop a New Technology 150-Seat Aircraft

While all three major airframe manufacturers have the technological ability to develop a new 150-seater aircraft, they do not all have the same financial capacity to do so.

U.S. government policy does not favour and direct financial assistance for any of its aerospace manufacturers to develop a new aircraft. Consequently, the two major U.S. airframe manufacturers, Boeing and McDonnell-Douglas, are forced to rely on retained earnings and debt and/or equity raised from the capital markets to finance new aircraft developments.

The projected debt capacities of Boeing and McDonnell-Douglas, which take into account their projected profitability, show that McDonnell-Douglas does not have the required resources to develop a new 150-seater aircraft and that Boeing will also have difficulties in finding sufficient resources, to develop a new 150-seater on its own. Boeing would prefer to both delay ints introduction of a new 150-seater aircraft and to develop a new aircraft with equity participation of Japanese.

Without government financing assistance, Airbus Industrie, too, would be unable to develop a new technology 150-seater aircraft. Airbus Industrie, however, reflects a consensus of common European government objectives. As a consequence of the commitment to the establishment of Airbus Industrie, these governments have been willing to lend political support to Airbus activities and have backed their support with concessionary development financing and concessionary export financing.

3.2.5 Analysis of the Current Strategic Gap and Development of Anticipated Strategies

Airbus

The current product portfolio will not achieve the corporate objective of a 30% world share. Even the present Airbus performance may be endangered since Boeing has stated its intention to capture 55% of the market served by the A310/A300. To achieve a 30% market share, Airbus must expand into other market segments (the A320), since a strategy which uses the present products alone will fall short of the corporate objectives.

Since the launch of the Airbus A320, a new technology 150-seat aircraft, is required for Airbus Industrie to meet its corporate objectives and to fill a product line gap, it is likely that the three European governments of Airbus Industrie will agree to the launch of the A320.

Table 1, following, summarizes the anticipated Airbus strategy.

Boeing

Boeing does not currently have a strategic gap. References to the Boeing corporate objectives (domination of the world civil aircraft market and a reduction of its debt/equity ratio) shows that these are achieved or achievable with the company's present or known future product portfolio.

Boeing believes it can capture 55% of the sales in the segments served by the A300 and A310 aircraft. Boeing also believes that its 737-300 derivative and 757 aircraft will adequately serve the requirements of airlines wanting aircraft in the 140-170 passenger capacity segment (the Boeing "gap"). However, the launch of a 150-passenger new technology aircraft (the antici-

pated A320) would result in a product gap. This gap will threaten the achievement of Boeing's corporate objectives and pose a strategic threat.

Table 2, following, summarizes the anticipated Boeing strategy.

McDonnell-Douglas

The current McDonnell-Douglas product line will allow McDonnell-Douglas to stay in the commercial aircraft market. Since the market potential for single-aisle aircraft appears very large, McDonnell-Douglas' strategy is to develop derivatives to compete in the single-aisle aircraft passenger market, given the limited financial resources of the company.

The company is attempting to establish and maintain the DC9-80 aircraft in as many airline fleets as it can. Once the DC9-80 aircraft is in airline fleets, airlines will have strong reasons to continue with the DC9-80, especially if the new 150-seat aircraft is not significantly better in economic terms.

The launch of a new technology 150-passenger aircraft by a competitor would, however, create a strategic gap. McDonnell-Douglas would not likely have the financial resources to launch a new technology 150-passenger aircraft of its own. Furthermore, the DC9-80 may not be able to compete profitably against the new aircraft.

Table 3, following, summarizes the anticipated McDonnell-Douglas strategy.

TABLE 1

SUMMARY: AIRBUS INDUSTRIE ANTICIPATED STRATEGY

CORPORATE OBJECTIVES	1. Achieve a 30% share of the world passenger jet market. 2. Become a full-line competitor. 3. Establish Airbus as the number 2 world producer of civil jet aircraft.
CURRENT PERFORMANCE	The current product line will yield only a 23% world market share.
GAP	7% market share.
STRATEGIC ALTERNATIVES	1. Develop a new technology single-aisle aircraft. 2. Develop the TA9 to compete in the 270-350 passenger market segment. 3. Develop a long-range 200 passenger aircraft.
STRENGTHS	Strong financial backing from European governments. The non-American image of Airbus favours sales to airlines in many parts of the world.
WEAKNESSES	The decision-making process is slow because consortium (government) approval is required for major business decisions. The requirement for level production (no layoffs policy) may result in an inability to adjust production levels to meet cyclical demand.
STRATEGIC OPPORTUNITY	The largest potential market is in the 150 seater segment. The Airbus corporate objective can be achieved with the A320 in the product line.
THREATS	Boeing may erode sales of the current product line (A310/A300) with its 767 aircraft and thus reduce the projected Airbus market share.
ANTICIPATED STRATEGY	Airbus will launch the A320 aircraft to compete in the single-aisle market. After introduction in 1988-89, Airbus will pursue the development of derivatives and/or new aircraft types to compete with the Boeing family of aircraft.

TABLE 2

SUMMARY: BOEING
ANTICIPATED STRATEGY - 150 SEATER INTRODUCED

CORPORATE OBJECTIVES	1. Maintain a greater than 50% share of the world market. 2. Reduce the debt/equity ratio to the historical (low) level. 3. Provide full product coverage in all segments of the market.
GAP	Potential strategic gap posed by entry of a new 150 passenger new technology aircraft.
CURRENT PERFORMANCE	The 737-300 and 757 sales will be threatened by the A320 and the overall Boeing market share might fall to 50%.
STRATEGIC ALTERNATIVES	1. Attempt to compete against the A320 with the current 737-300 and 757 aircraft. 2. Develop a new technology single-aisle aircraft to compete with the A320. 3. Develop a derivative (737-400) to compete directly against the A320.
STRENGTHS	The Boeing design team can produce a new aircraft faster than any other airframe manufacturer. Boeing has lower production costs than competitor airframe manufacturers. The Japanese have expressed interest in becoming 30% equity partners in a single-aisle aircraft.
WEAKNESSES	Cash constraints arising from a downturn in aircraft sales and because of massive new aircraft development programs. Boeing wants to protect the sales prospects of its 757 and 737-300 products. Boeing's traditional launch customers are large American airlines. These airlines are, in general, not profitable now.
STRATEGIC OPPORTUNITY	Largest market in the period 1982-2002 is in the single-aisle segments.
THREATS	Boeing may lose its dominance of the narrow body market if the A320 is able to displace the present 737 and 757 series aircraft.
ANTICIPATED STRATEGY	Boeing will wait as long as possible to incorporate the latest technology into a new single-aisle aircraft. It will then launch a 7-7, in partnership with the Japanese, to compete with the A320. The introduction of the 7-7 could be as much as two years after the entry into service of the A320.

TABLE 3

SUMMARY: McDONNELL-DOUGLAS
ANTICIPATED STRATEGY - 150 SEATER INTRODUCED

CORPORATE OBJECTIVE	Maintain a presence in the commercial aircraft market for as long as possible to exploit a large single-aisle market potential.
CURRENT PERFORMANCE	Current product line may not achieve desired corporate objectives.
GAP	The DC9 aircraft may not be able to compete profitably in the single-aisle aircraft market.
STRATEGIC ALTERNATIVES	1. Develop or improve derivatives to compete in the single-aisle market. 2. Exit from the market.
STRENGTHS	The DC9-80, a single-aisle aircraft, is presently in the company product line and is in airline fleets in substantial numbers. Derivatives of current aircraft can be developed to compete in other segments of the narrow body market.
WEAKNESSES	Financial cash flow constraints do not permit McDonnell-Douglas to build a new technology narrow-body aircraft.
STRATEGIC OPPORTUNITY	The single-aisle aircraft market is the largest market segment in the period 1982-2002
THREATS	A new technology single-aisle aircraft may be so advanced as to make the DC9-80 economically unattractive for airlines.
ANTICIPATED STRATEGY	McDonnell-Douglas will pursue sales of the DC9 aircraft for as long as possible. Furthermore, McDonnell-Douglas will compete only in areas where the DC9-80 has economic advantages to offer airlines. If the market size for the DC9-80 is too small, McDonnell-Douglas will exit from the market.

3.3 Market Shares of New 150-Seater Aircraft

The market shares that each airframe manufacturer can capture of the new 150-seat aircraft market depends on several factors. These factors include:

- the effects of political factors on the potential supply of aircraft;
- the economic attractiveness of new aircraft to airlines (measured by selling price and direct operating costs) relative to competitive aircraft;
- the unwillingness of airlines to mix aircraft types of the same passenger capacity;
- the marketing and financing practices of the aerospace manufacturers affecting aircraft demand;
- the production constraints faced by Airbus Industrie because of a requirement to retain a level workforce.

Effect of Political Factors on the Potential Supply of Aircraft

The political factors affecting aircraft purchase were developed through a survey of Purchase Influencing Factors (Boeing vs. Airbus) conducted through Canadian Embassies by the Department of Industry, Trade and Commerce. The survey indicated a strong bias, in many non-U.S. countries, favouring the purchase of Airbus aircraft if technical and financing factors were equal.

The market share ranges for Airbus and Boeing, as determined by the survey, are as follows:

Market Share Ranges

	Airbus Industrie	Boeing
Europe	53 - 86%	14 - 47%
North America	0 - 19%	81 - 100%
Other	32 - 61%	39 - 68%
World	23 - 49%	51 - 77%

Our assessment of the market shares for the Boeing 7-7 and the A320 incorporates the impact political factors may have on sales.

Economic Attractiveness of New Aircraft to Airlines

While the 727 (a 150-seater) is being phased out of production, Boeing is offering the 737-300 and the 757 as alternatives. The most direct competition to the proposed A320 with 156 seats is presently the DC9-80 with 152 seats.

An economic comparison between the DC9-80, Boeing 737-300 and the A320 indicates, broadly speaking, that the A320 would be economically viable in the $27 million to $30 million price range (U.S. dollars), depending on stage length, fuel price and on the airlines' cost of capital. Sources in the British government have indicated a probable price of about $28 million (in current 1983 dollars) for the A320. At this price, the A320 can hope for a reasonable market share.

Unwillingness of Airlines to Mix Fleets

Airlines do not want different aircraft from different manufacturers with the same passenger capacities because of the economic costs associated with mixed fleets. Thus, airlines would react unfavourably to having both the DC9-80 series aircraft and A320 in their fleets. With McDonnell-Douglas

introducing as many DC9-Super 80's into airline fleets as it can before the first A320's are delivered, Airbus A320 will have a smaller potential client base because airlines will be reluctant to mix the DC9-Super 80 and the A320. This factor tends to reduce the potential market share of the A320 and has been incorporated into our assessment.

Effects of Marketing and Financing Practices on Aircraft Supply

The Airbus share is vulnerable in a rising market because its level production policy will cause it to lose market share to Boeing who are able to adopt a flexible production policy. Boeing is, however, vulnerable to Airbus pricing in a weak market since Boeing, as a publicly-owned corporation, has more limited resources than Airbus and because the U.S. government support for concessionary financing has not tended to be as generous as the European support. Market share gains in a weak market are not as significant as the market share gains in a strong market. Consequently, the Airbus share is generally always less than Boeing's.

Effect of Airbus Production Constraints

The market shares do not reflect Airbus production constraints. Airbus, because of its inability to contract or expand the production of the A320 to meet market requirements, will miss some sales opportunities. Airbus production constraints, mandated by European government policy to maintain long-term steady employment reduce the potential supply of aircraft by Airbus by 3%.

Expected Market Shares for 150-Seater Aircraft Including the A320

Our assessment of the anticipated strategies of Airbus, Boeing and McDonnell-Douglas, and of several factors affecting market shares outlined earlier,

results in the expected market shares for 150-seater aircraft shown in Exhibit 7, following.

The market share ranges for the Airbus A320 shown in Exhibit 7 are, however, uncertain. The high, expected and low market shares for the Airbus A320 are shown in Exhibit 8, following.

A320 Delivery Scenarios

The projected 150-seat aircraft requirements for the low, base and high traffic growth scenarios shown in Exhibit 9, following, and the market share ranges for the A320 aircraft (Exhibit 8) translate into the A320 deliveries scenarios for the period 1988-2002 shown in Exhibit 10, following. The A320 should achieve sales of 500-900 aircraft in the 1988-2002 period if the base traffic forecast materializes.

CAVEAT

This analysis of the worldwide market for 150-seat new technology aircraft has been prepared based on available data from many sources. The analysis, and conclusions drawn from it, relate to possible future developments in a world wide industry over the last 20 years of the twentieth century. A number of assumptions have been made in the analysis and in arriving at our conclusions. Many technical, economic, social and political factors could alter or affect these assumptions. Actual experience may therefore differ significantly from the conclusions reached in this report.

EXHIBIT 7

EXPECTED MARKET SHARES FOR 150-SEATER AIRCRAFT BY MANUFACTURER

	Europe	N. America	Other	World
1988 - 1992				
Airbus	53%	8%	34%	29%
Boeing	27%	53%	38%	41%
McDonnell-Douglas	20%	39%	28%	30%
1993 - 1997				
Airbus	53%	8%	34%	27%
Boeing	47%	92%	67%	73%
McDonnell-Douglas	0%	0%	0%	0%
1998 - 2002				
Airbus	47%	7%	30%	25%
Boeing	53%	93%	70%	75%
McDonnell-Douglas	0%	0%	0%	0%

EXHIBIT 8

MARKET SHARE RANGES FOR THE AIRBUS A320

	Europe	N. America	Other	World
1988-1992				
Low	40%	4%	24%	21%
Expected	53%	8%	34%	29%
High	65%	12%	44%	37%
1993-1997				
Low	40%	4%	24%	20%
Expected	53%	8%	34%	27%
High	65%	12%	44%	36%
1998-2002				
Low	36%	4%	21%	18%
Expected	47%	7%	30%	25%
High	58%	11%	39%	32%

EXHIBIT 9

REQUIREMENTS FOR NEW 150 - SEATER AIRCRAFT
(LOW, BASE AND HIGH TRAFFIC GROWTH FORECAST)

	N. America	Europe	Other	Total
1988-1992				
Low Forecast	187	125	318	630
Base Forecast	220	171	365	756
High Forecast	273	198	411	882
1993-1997				
Low Forecast	305	143	232	680
Base Forecast	353	216	310	879
High Forecast	416	265	398	1079
1998-2002				
Low Forecast	322	127	269	718
Base Forecast	407	220	372	999
High Forecast	510	294	538	1342
1988-2002				
Low Forecast	814	395	819	2028
Base Forecast	980	607	1047	2634
High Forecast	1199	757	1347	3303

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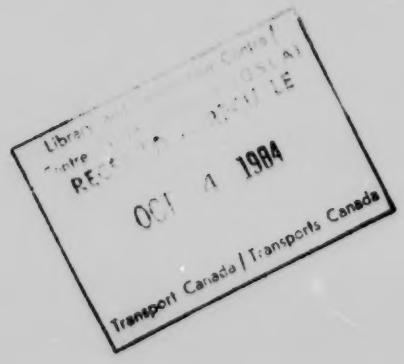
EXHIBIT 10

A320 DELIVERY SCENARIOS
1988-2002

TRAFFIC FORECAST	MARKET SHARE		
	LOW	EXPECTED	HIGH
LOW	373	532	689
BASE	503	701	919
HIGH	647	910	1177



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DEVELOPMENT POTENTIAL FOR THE 150-SEAT NEW TECHNOLOGY AIRCRAFT FOR THE 1990'S

by

A. Elek, L.R. Murdoch and R.W.J. Sturgess
Peat, Marwick and Partners
Toronto, Ontario

September, 1983

The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre - Transport Canada.

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17. Abstract

The purpose of this study was to investigate the development and market potential of a new technology 150-passenger aircraft. The work was part of an overall evaluation program by the federal government to identify and assess Canada's opportunities for participation in the development and production of such aircraft.

The study examined the economic environment of the world aerospace industry, predicted timing of airline requirements for new aircraft, and analyzed presumed corporate objectives and strategies of airframe and engine manufacturers. The study also addressed the impact of manufacturers' marketing practices and examined the strategic gaps and product portfolio gaps of each manufacturer. From these assessments each competitor's likely share in the 150-seat market was estimated for the 1988-2002 period.

The study concluded that there is a definite need for a fuel-efficient aircraft incorporating new technology, with the proposed Airbus A320 achieving sales of 500-900 aircraft in the 1988-2002 period if development and production costs can be kept under tight control. Boeing and McDonnell-Douglas are considered unlikely to embark on the development of a totally new aircraft in the near future. Boeing will eventually build an all new 150-seat aircraft, possibly with Japanese involvement, while McDonnell-Douglas will attempt to compete with the existing DC9 Super 80 line.

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17. Résumé

Cette étude avait pour objet de cerner les possibilités de lancement sur le marché d'un avion commercial 150 places de technologie avancée, et aussi d'en déterminer les perspectives commerciales le cas échéant. L'étude entrait dans le cadre du programme lancé par le gouvernement fédéral pour reconnaître et évaluer le créneau concerné ainsi que l'intérêt pour le Canada de participer à son exploitation.

L'étude a fait un tour d'horizon des perspectives économiques de l'industrie aérospatiale mondiale, déterminé quand les compagnies aériennes renouvelleraient leur parc et sondé les objectifs et les stratégies que les avionneurs et les motoristes voudront vraisemblablement se donner à cet égard. Enfin, elle a évalué les orientations commerciales des divers constructeurs et leurs effets sur le marché, les mettant en rapport avec les créneaux que ces constructeurs voudront ou ne voudront pas éventuellement exploiter. Il en est résulté un bilan comparatif de la part du marché pouvant être occupé par les entreprises visées, à l'horizon 1988-2002.

En conclusion, il existe effectivement un créneau pour un avion à consommation améliorée et à technologie de pointe, l'Airbus A320 devant atteindre pour la période considérée un chiffre de ventes situé entre 500 et 900 exemplaires, si toutefois les coûts de développement et de production restent fermes. Il ne semble pas que Boeing et McDonnell-Douglas soient prêtes à se lancer dans cette aventure dans un avenir rapproché. Eventuellement, Boeing lancera un avion complètement nouveau dans la catégorie des 150 passagers, avec la participation possible des Japonais, tandis que McDonnell-Douglas tentera sa chance avec son DC-9 Super 80.

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1. INTRODUCTION

1.1 TERMS OF REFERENCE

At the request of the Transportation Development Centre, Peat Marwick has undertaken a study of the development potential for the 150-seat new technology aircraft for the 1990's. The study is part of an overall evaluation program carried out by the federal government to identify and assess Canada's opportunities for participation in the development and production of such aircraft.

The scope of the study included:

- studying the airframe manufacturers' corporate objectives, strategies and business portfolios to assess their current and future strengths and weaknesses;
- examining the objectives and strategies of the engine manufacturers to determine if a suitable new technology engine will be available to power a new technology 150-seat aircraft;
- determining the strategic and product portfolio gaps of the major competitors and assessing their future strategic postures;
- projecting the market shares of the major competitors, including Airbus Industrie, for the period 1988-2002.

1.2 RESEARCH METHODOLOGY

In undertaking this study, our work involved seven tasks, as follows:

- a detailed examination of industry background to assess the development of the aerospace industry in the last 20 years, to determine the economic and technological changes and forces that are now paramount, to examine historical trends in commercial aircraft demand and to assess the major shifts and trends in airframe design;

- an overview of airlines to examine the present world fleets, examine forecasts of air travel growth, and identify the timing of and size of airline requirements for new aircraft;

- a study of the airframe manufacturers' corporate objectives and product portfolios to develop projections and the product plans of each of the major competitors in the 1983-2002 period;

- a review of engine manufacturers to identify their objectives, strategies and new engine plans;

- an examination of the manufacturers' marketing and financial practices to identify methods by which they seek to influence aircraft purchasing;

- a study of the strategic gaps and product portfolio gaps of each manufacturer to identify market gaps or niches that will likely occur;

- an estimate of the market shares of each competitor in the 150-seat aircraft market taking into consideration variables such as the marketing practices of the competing manufacturers, financing practices, political considerations, performance characteristics of competing aircraft and fuel prices.

The sources of data used in conducting the study have included:

- literature in journals, research documents and newpaper articles;
- company annual reports;
- investment analyst reports;
- interviews with airline officials, airframe manufacturers and engine manufacturers in North America and Europe;
- statistical information produced by ICAO, FAA, CAB, IATA;
- forecasts produced by Pratt and Whitney, General Electric, Rolls-Royce, Airbus, Boeing, McDonnell-Douglas and others.

1.3 SUMMARY OF MAJOR FINDINGS

Although it is difficult to predict corporate strategies with certainty, reasonable conclusions can be reached from the findings of this study. These are the main points:

- There is a definite need for a fuel-efficient aircraft that incorporates new technology, between the general size of

the Boeing 737-300 and that of the Boeing 757. Since, in all-economy configuration, the former aircraft accommodates up to 137 passengers and the latter more than 200, the most logical size of an intermediate class would be an aircraft accommodating up to 170 passengers.

- Two aircraft types, existing or proposed, are in that range. The McDonnell-Douglas DC9-Super 80 has a maximum of 152 seats: somewhat too close to the size of the B737-300 and too far from the next higher class, the B757. It is, nevertheless, an improved-technology, fuel-efficient aircraft and, being a derivative of the well-established DC9 group, is available at a price that many airlines may find economical.

- As originally announced, the Airbus A320 would have accommodated a maximum of 162 passengers at a seating density equivalent to the density of the aircraft types mentioned above. Because of its larger size and improved fuel-efficiency, it would have been significantly superior to the DC9-Super 80 in economic terms, even though its price would have had to include the recovery of substantial development costs. The size of the proposed A320 has recently been reduced to 158 seats which decreased, to a certain extent, both the economic advantage of the aircraft and its compliance with the most desirable size.

- Broad estimates of the economies provided by the proposed A320 indicate that, if development and production costs can be kept under tight control, sales of 503-919 aircraft could be achieved in the 1988-2002 period and that the recovery of the A320 development costs would seem possible.

The major initial competitor to the proposed A320 would be the DC9-Super 80 which, by 1988, would be operated by many airlines in the world. Because of the small difference in seating capacity between the newly proposed A320 and the DC9-Super 80 and the reduced difference in economies, those airlines which have already committed themselves to the DC9-Super 80 by 1988 would be unlikely to opt for having two different types of aircraft of similar size in their fleet. This is expected to limit the A320's market share and its sales volume to the range indicated above.

- The likelihood of Boeing or McDonnell-Douglas embarking on the development of totally new aircraft to compete with the A320 is relatively small in the near future. Boeing would have to sacrifice a certain percentage of the sales of the B737 and B757 if an aircraft with the newest technology that is not too far in size from the two existing types were introduced. It is not likely that Boeing would find this to be a financially feasible policy until more of the B757 development costs have been recovered. McDonnell-Douglas, after many years of losses in the commercial aircraft sector, may not allocate substantial investment to that sector, particularly not for the development of a 150 seat aircraft that would compete directly with the DC9-Super 80 which Douglas has just introduced.

- These considerations favour the entry of the A320 into the marketplace as long as it occurs within the next five to six years. If Airbus Industrie waited much longer, for example for an engine design that is different from the proposed CFM56-4, the considerations expressed above in relation to the posture of the competitors, may no longer

be valid. These considerations must be weighed by Airbus against the potential advantages of an engine that could make it possible to increase the size and the economies of the A320 to more favourable levels in relation to those of the DC9-Super 80.

The background of these conclusions is discussed in detail in our report.

1.4 GLOSSARY

Refer to Appendix C for a complete description of terms used in this report. Some terms commonly used in this report include for example:

- Airbus refers to Airbus Industrie;
- Aircraft designations are referred to by their commonly accepted numbers without the use of the manufacturer's name:

  i.e., B757 or 757 refers to the Boeing 757,
  A320 refers to the Airbus A320,
  DC9-80 refers to the McDonnell-Douglas DC9-Super 80;

- Narrow-body or single-aisle refers to aircraft seating a maximum of six passengers abreast.

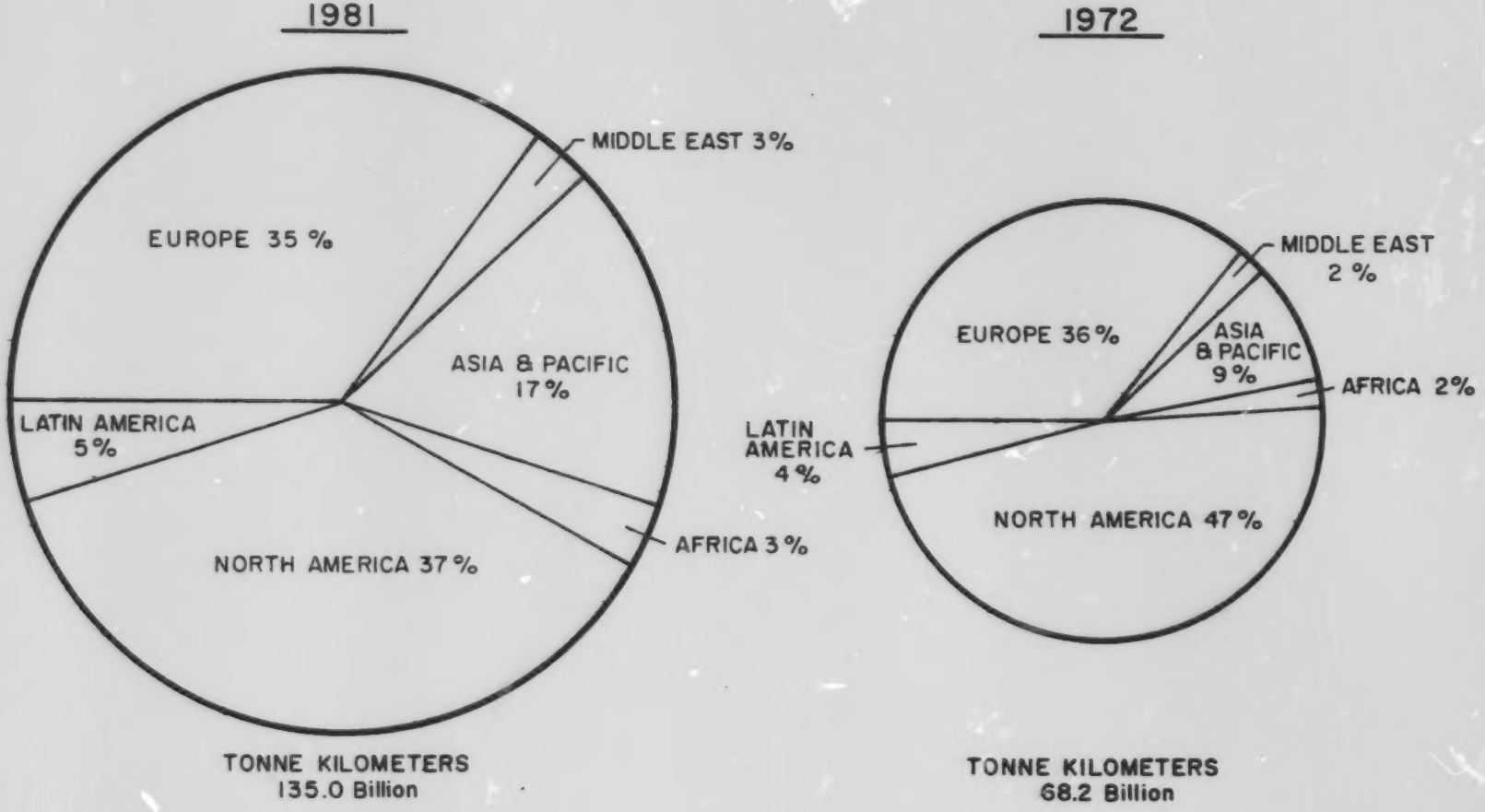
1.5 CAVEAT

This analysis of the worldwide market for 150-seat new technology aircraft has been prepared based on available data from many sources. The analysis, and the conclusions drawn from it, relate to possible future developments in a

worldwide industry over the last 20 years of the twentieth century. A number of assumptions have been made in the analysis and in arriving at our conclusions. Many technical, economic, social and political factors could alter and affect these assumptions. Actual experience may therefore differ signficantly from the conclusions reached in this report.

EXHIBIT I

SHARE OF SCHEDULED TRAFFIC BY REGION



SOURCE: ICAO Civil Aviation Statistics of the World 1981.

2. AEROSPACE INDUSTRY PERSPECTIVE, 1962-82

2.1 AIRLINE INDUSTRY DEVELOPMENTS

2.1.1 Growth in Air Travel

Passenger travel (measured in revenue passenger kilometres) has enjoyed phenomenal growth in the period 1962-1982, averaging 10% per year. However, high passenger travel growth rates have started to diminish. Future growth rates are now projected to be about 5% per annum.

Civil air traffic growth has not been uniform. The share of the world air traffic outside North America and Western Europe has been growing. In the period 1972-1981, the combined North American and European share of commercial air traffic fell from 84% to 72% as shown in Exhibit 1, opposite.

Air traffic growth has been affected by economic factors. Economic growth in many countries has been far higher than in North America and Europe. Furthermore, since the air services in many of these countries are much less developed than in North America or Europe, they have a greater scope for growth in air travel. The steep rise in fuel prices in the 1970's has slowed the rate of growth of the economies of the world, negatively impacting air traffic growth.

2.1.2 Fleet Development - Present Fleets

Reflecting the shifts in world passenger traffic to regions other than North America and Europe, the airline fleets in these regions have grown dramatically. However, because of economic factors, differences in air travel development and geography, the fleet mixes in each geographic region vary considerably.

The North American (United States and Canada) fleet is the largest in the world, accounting for 43% of the world fleet in 1981. The second largest passenger aircraft fleet is in Western Europe which has 21% of the world fleet. The rest of the world accounts for the remaining 36% of the world fleet.

The predominant class of aircraft in the world is the short range, 110-seat generic class as shown in Exhibit 2, opposite, while the second largest class is the short-range, 150-seat generic class.

Examining the 110 and 150 seat classes worldwide, North America accounts for the largest shares of both these generic classes. While the North American share of the 110 class is slightly larger than the European share, North American fleets in the 150 class (B727 and DC9-Super 80 aircraft) clearly dominate. The short range 150 seat class is presently operating mostly in the North American market as seen in Exhibit 3, following.

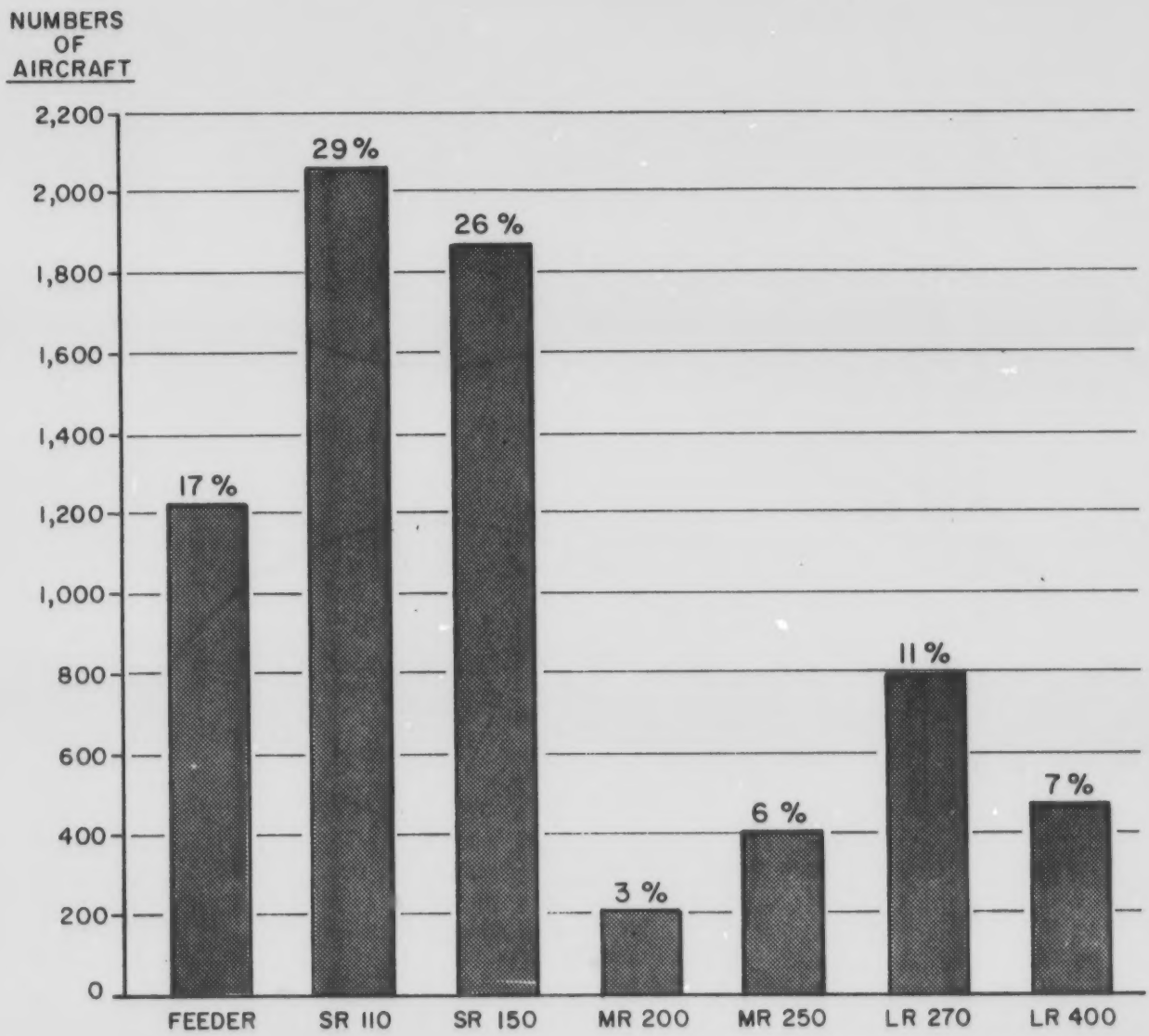
Outside North America, the predominant class is the short-range, 110-seat generic class (Exhibit 4, following). In fact outside North America, the fleet size in this generic class is more than twice the fleet size in the short-range, 150-seat generic class. The short-range 110-seat generic class includes such aircraft as the DC9-10/30, B737-200, F-28 and the BAC-111.

2.1.3 Aircraft Requirements

A discussion of the effects of aircraft age, stricter noise standards, overcapacity, aviation fuel prices, air traffic growth, airframe manufacturer competition and deregulation in the U.S. on future fleet requirements follows. The economics of current and potential aircraft in the 150-seat market affecting aircraft purchase decisions are examined in Appendix B.

EXHIBIT 2

DISTRIBUTION OF WORLD AIRCRAFT FLEET BY GENERIC CLASS (1981) *

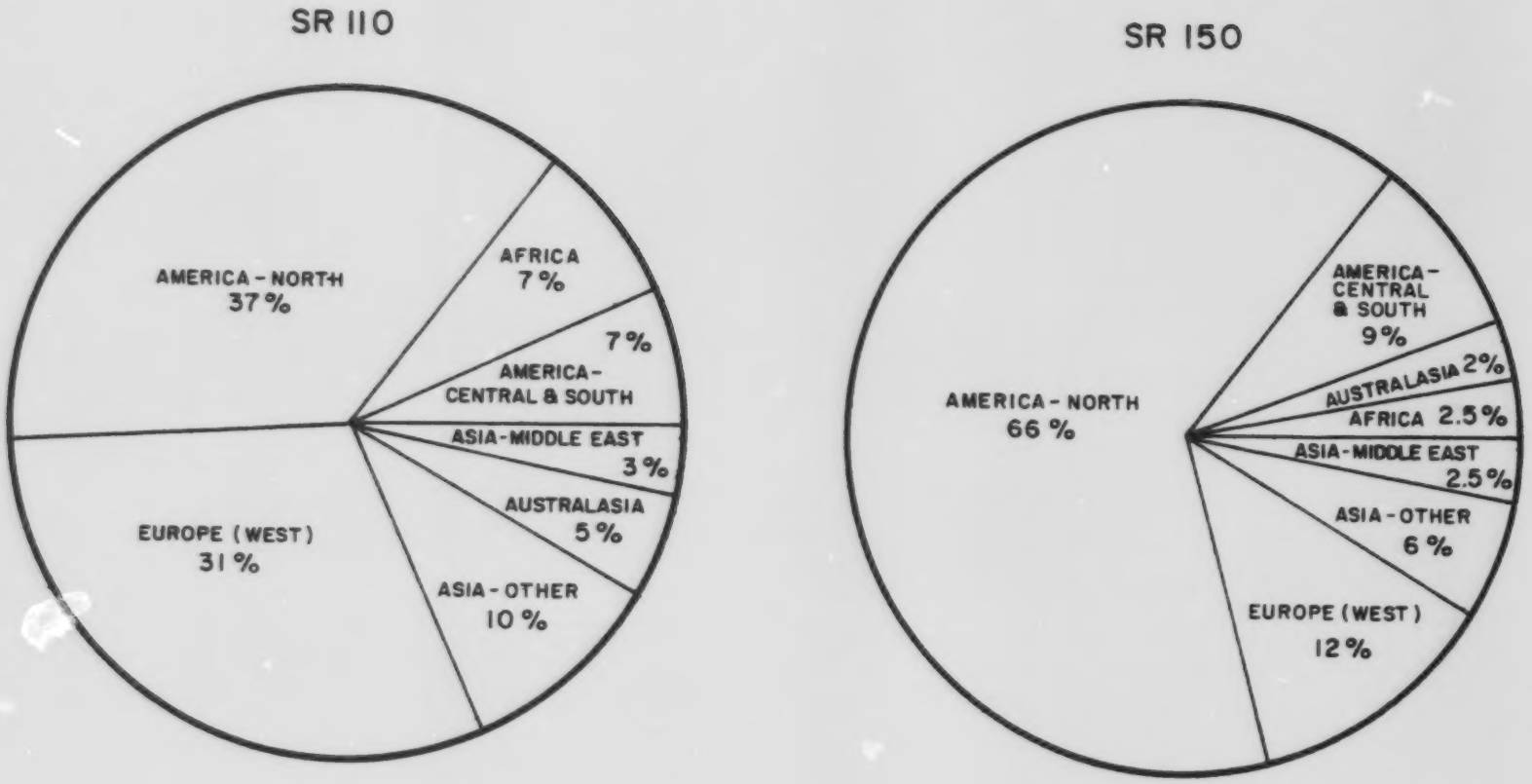


* Excluding Europe (East)

SOURCE: FLIGHT INTERNATIONAL

EXHIBIT 3

SHARES OF 150 SEAT GENERIC CLASSES BY GEOGRAPHIC REGION*



* Excluding Europe (East)

SOURCE: FLIGHT INTERNATIONAL, PEAT MARWICK ANALYSIS

EXHIBIT 4

WORLD AIRCRAFT FLEET BY GENERIC CLASS

(1981)*

GEOGRAPHIC REGION	FEEDER	SR 110	SR 150	MR 200	MR 250	LR 270	LR 400	TOTAL
Africa	214 (42%)	136 (27%)	50 (10%)	21 (4%)	8 (2%)	70 (14%)	12 (2%)	511 (7%)
America - Central & South	159 (27%)	154 (26%)	168 (29%)	9 (2%)	8 (1%)	70 (12%)	14 (2%)	582 (8%)
America - North	266 (9%)	759 25%)	1229 (41%)	86 (3%)	290 (10%)	223 (7%)	149 (5%)	3002 (43%)
Asia - Middle East	60 (17%)	70 (24%)	51 (18%)	41 (14%)	30 (10%)	66 (23%)	33 (11%)	351 (5%)
Asia - Other	242 (28%)	212 (25%)	107 (12%)	6 (1%)	42 (5%)	135 (16%)	115 (13%)	859 (12%)
Australia	50 (22%)	103 (45%)	37 (16%)	--	--	13 (6%)	25 (11%)	228 (3%)
Europe (West)	241 (16%)	629 (42%)	224 (15%)	36 (2%)	20 (1%)	217 (15%)	121 (8%)	1488 (21%)
World [excl. Europe (East)]	1232 (18%)	2063 (29%)	1866 (27%)	199 (3%)	398 (6%)	794 (11%)	469 (7%)	7021

* Excluding Europe (East)
SOURCE: Flight International

Effect of Aircraft Age

At the end of 1981, the world passenger jet fleet had the following age distribution:

Age of World Passenger Fleet	Percentage of Total World Fleet
0 - 5 years	23%
5 - 10 years	20%
10 - 15 years	33%
15 - 20 years	16%
20+ years	9%

Conventional economics indicate that an aircraft should reach the end of its physical life after 25 years of service. Therefore, as much as 25% of the present world fleet will be physically obsolete within the next 10 years and need replacement.

Effect of Stricter Noise Standards

Aircraft replacement may be accelerated by the stringent noise standards which will be imposed by governments on airlines. The new and tougher FAR 36 Stage 3 noise regulations are to become effective in many countries in the mid-80's, especially in the United States and Western Europe. Much of the fleet which is older than 10-15 years will be affected by this regulation and may have to be scrapped, redeployed to areas where the noise regulations do not apply or re-engined with quieter engines to comply with the stricter noise standards.

Effect of Overcapacity

According to a Senior Vice President of a major European airline, there is an "excess of between 100 and 125 wide-body aircraft and about 450 narrow-body

aircraft worldwide: enough excess aircraft to handle four years of moderate growth with no additional aircraft purchases." Estimates of economically obsolete aircraft range from 25-30% of international fleets. However, many of the narrow-bodies are uneconomic to fly. The net effect of the overcapacity has been a virtual disappearance of new orders for wide-bodies. In 1982, about 80-90% of current orders were for narrow-body aircraft.

The single-aisle aircraft segment of the market should be the more attractive aircraft segment until the surplus of large aircraft is absorbed.

Effect of Aviation Fuel Price Rises

Fuel costs have risen dramatically since 1970 as illustrated in Exhibit 5, following. Fuel costs have risen from about 10% of total airline costs in 1970 to about 30% in 1982, forcing airlines to raise airfares which in turn has slowed down air travel growth.

Fuel prices are not uniform worldwide. In 1982, U.S. fuel prices averaged $1.00 per U.S. gallon (in U.S. dollars) while European fuel prices averaged $1.20, as shown in Exhibit 5. In some parts of Africa and Asia, aviation fuel prices are as much as $2.00 or $3.00 per gallon.

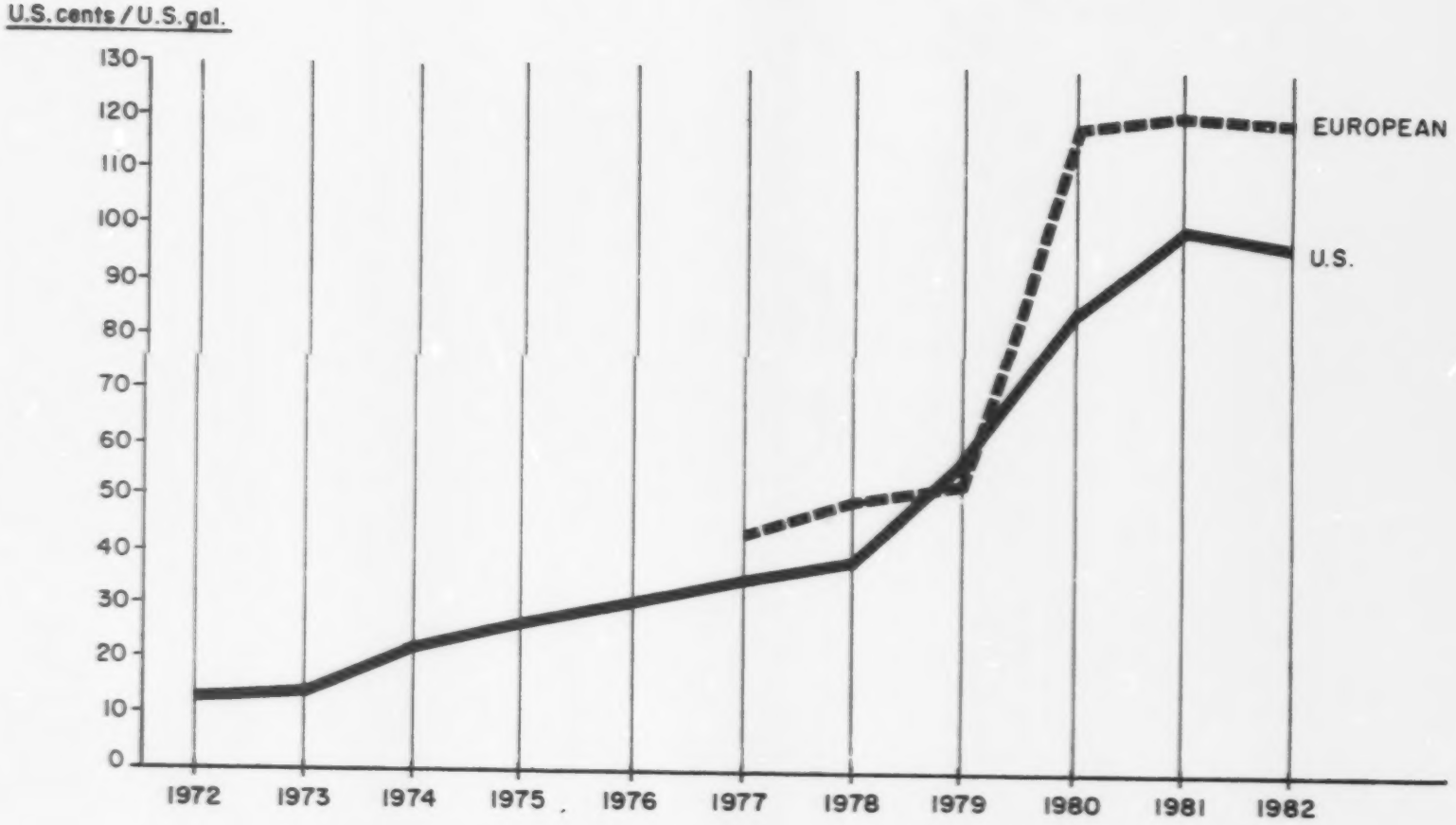
Airlines have been purchasing fuel-efficient aircraft in an effort to reduce the impact of fuel costs on total operating costs and to replace aircraft that have become obsolete because of rising aviation fuel costs.

Effect of Air Traffic Growth

Historical pre-deregulation data in the U.S. suggest that for every doubling of Available Seat Kilometers, average aircraft size grows by 26%, while the average number of aircraft increases by 56%. This suggests that airlines will purchase larger aircraft to replace smaller aircraft to accommodate traffic

EXHIBIT 5

AVIATION FUEL PRICES



SOURCE: CAB and ICAO

growth and to take advantage of better aircraft economics. Thus, conventional wisdom suggests that a 727 (150 seater) replacement will be a 757 (185 seater), and a DC9-30 (110 seater) replacement will be a 150 seat aircraft.

While the average seating capacity of airline fleets is likely to rise, fleet sizes will rise. Aircraft manufacturers forecast that as many as 6,000 new aircraft will be required in the period 1982-2000. The impact of these requirements on the single-aisle category are explored in Appendix A.

Effect of Airframe Manufacturer Competition

Airlines prefer to purchase aircraft from competing manufacturers. Thus they strive to maintain at least two suppliers. This enables airlines to purchase aircraft on more favourable terms than they otherwise could in the absence of competition. Furthermore, this competition has led to the development of improved, more fuel efficient aircraft.

Effect of Deregulation in the United States

Deregulation, introduced by the U.S. government in the late 70s, has had a substantial impact on U.S. airlines. The primary impacts have been on airline fleets, industry structure and fares. Airlines are uncertain as to the future fleet mix required and are, in general, much weaker financially. Any launch orders for a new technology 150-seat aircraft from U.S. airlines are likely to be both smaller and more uncertain than in the past. A table outlining the effects of deregulation is given in Exhibit 6, overleaf.

2.1.4 Financial Aspects of Airline Operations

A new Boeing 757 costs about $32 million and a new DC9-Super 80 has a list price of about $22 million. Typical aircraft purchase deals are often in excess of $1 billion. Clearly, airlines are in an expensive, capital-intensive business.

EXHIBIT 6

THE IMPACT OF DEREGULATION
ON U.S. AIRLINES

IMPACT	IMPLICATIONS FOR A320
I. FLEETS	
I.1 EXCESS SUPPLY OF LARGE AIRCRAFT	PLANNERS UNCERTAIN ABOUT SIZE, NUMBER, AND MIX OF AIRCRAFT IN FLEET
I.2 INCREASED CAUTION IN PURCHASING NEW AIRCRAFT	LAUNCH ORDERS OF MAJOR CARRIERS UNCERTAIN AND/OR SMALLER
II. INDUSTRY STRUCTURE	
II.1 12 NEW ENTRANTS	SMALL CARRIERS DEMANDING SMALLER AIRCRAFT NOW IMPACTS ON TIMING OF A320
II.2 COMMUTER AIRLINES GROWING	LEAD CARRIERS LOSING FINANCIAL ABILITY TO COMMIT TO LAUNCH ORDERS
II.3 MARKET CONCENTRATION DECLINING	POTENTIAL LARGE BANKRUPTCIES COULD LEAD TO RENEWED REGULATION AND A DIFFERENT FLEET MIX
III. FARES	
III.1 LOW FARES	MAJOR AIRLINES HAVE DEPRESSED YIELDS LAUNCH ORDERS UNCERTAIN

Airlines gain significant economies by minimizing the number of airframe types and engine types they carry. These economies occur because the investment in additional spares, training, and components, falls significantly with increases in the fleet size of aircraft sharing common components, and powered by engines in the same engine family. Airlines thus have powerful economic pressures not to purchase several aircraft types from different manufacturers to meet a specific aircraft size requirement. Consequently, an airline would not likely have both DC9-30s and 737-200s in its fleet. Furthermore, an airline will prefer not to have both Rolls-Royce and Pratt and Whitney engines powering its Boeing 757 fleet.

Aircraft Purchase Decision

In purchasing a new aircraft, an airline will examine the following factors:

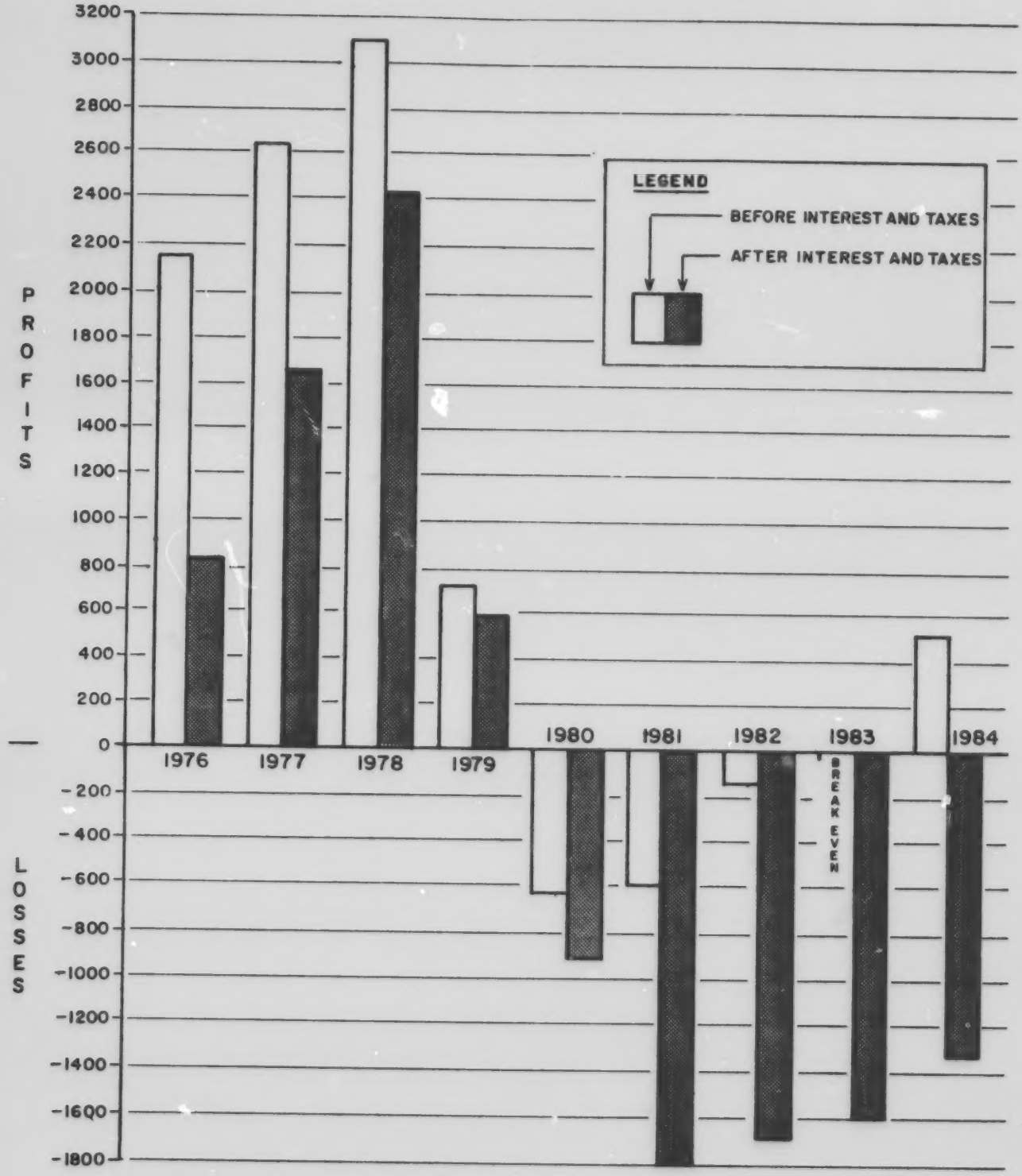
- its route structure;
- the age of its present fleet;
- the composition of its present fleet;
- promised operating savings of new airplanes relative to current models in the fleet and to competitor models;
- expected passenger growth.

An airline will purchase an aircraft or a fleet of aircraft that will meet its present and expected future requirements. Generally, an airline will purchase a given aircraft type only if the operating economics of the prospective aircraft are favourable.

EXHIBIT 7

WORLD AIRLINE OPERATING RESULTS

(millions $ U.S.)



SOURCE: ICAO, IATA, AIR TRANSPORT WORLD, PEAT MARWICK ANALYSIS.

Ability of Airlines to Purchase Aircraft

In the period 1980 to 1982, the world operating results of airlines have been dismal. As seen in Exhibit 7, opposite, in 1981, the world airlines experienced the largest operating losses after interest and t[illegible] in history. However, since 1981, operating losses after interest and taxes have been declining. By 1984, operating results before interest and taxes should again be positive although, after interest and taxes, the losses will continue to be substantial.

The poor airline operating results have not been shared uniformly since considerable differences in operating profits (before interest and taxes) were achieved by individual airlines. In 1980, half of the airlines incurred losses, one-third reported a profit of 5 percent or less and the remaining one-sixth had a profit of more than 5 per cent of total operating revenues.

It is difficult to make an accurate assessment of profits by area of the world because of incomplete data. In our assessment, operating results before interest and taxes by area of the world appear as follows:

Airline Operating Results
($ million)

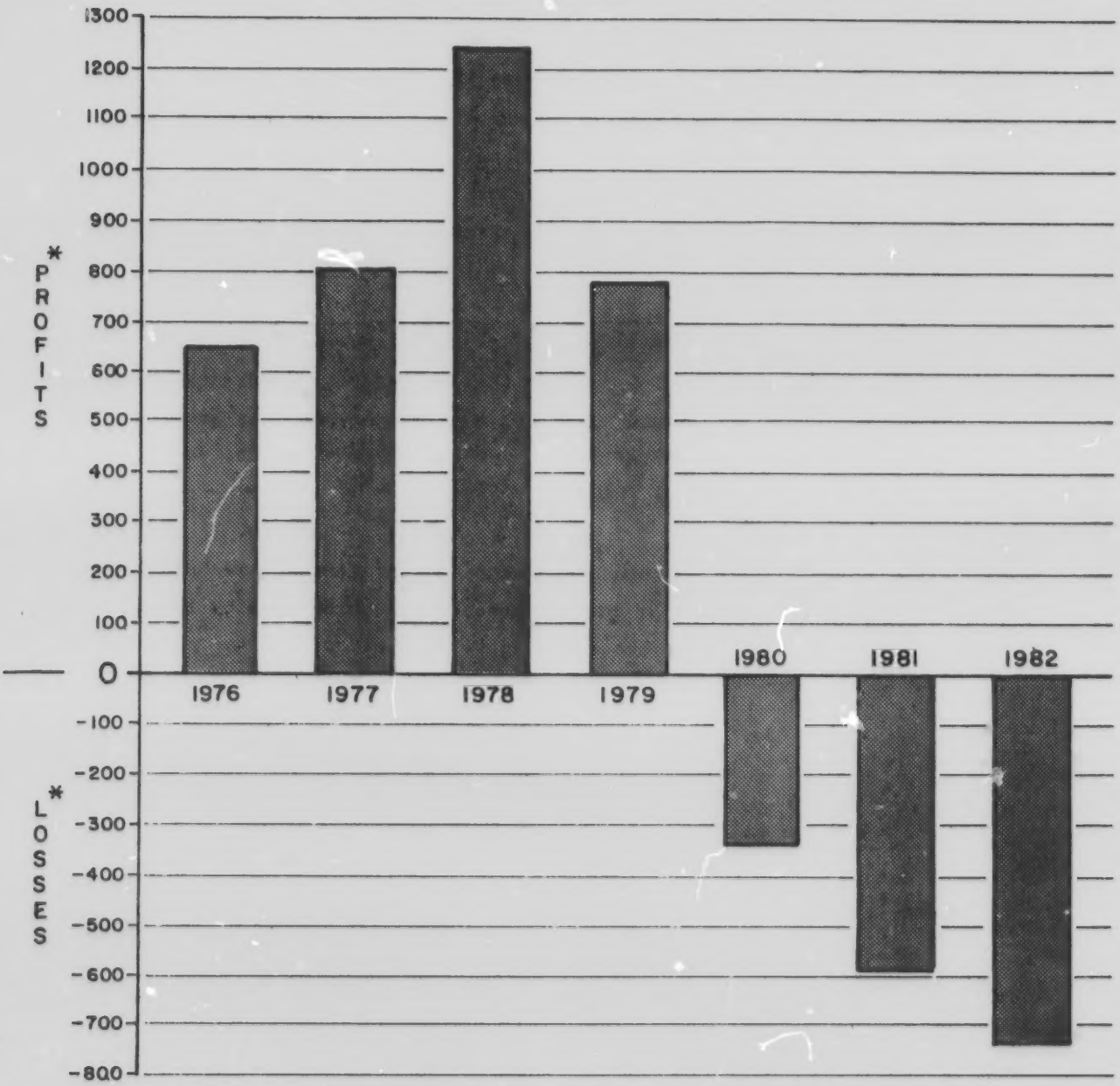
	Year		
	1980	1981	1982
Europe	-455	-455	-68
North America	-227	-340	-418
Other	+47	+195	+336
World	-635	-600	-150

Source: ICAO, Air Transport World and Peat Marwick Analysis

EXHIBIT 8

OPERATING RESULTS - ALL U.S. MAJORS

(millions $ U.S.)



* BEFORE INTEREST AND TAXES

SOURCE: CIVIL AERONAUTICS BOARD

These data show that airline operating results are now significantly better in Europe and in other parts of the world than in North America.

The operating results of the major U.S. airlines has shown a steady decline since 1978 as shown in Exhibit 8, opposite. Furthermore, the operating results of the major U.S. carriers, who have traditionally have been the launch customers for new aircraft programs, offer little hope that these airlines will provide large launch orders for a new 150-passenger aircraft in the near future.

In contrast to the performance of U.S. carriers, the operating results of most of the large European carriers are improving, as shown in Exhibit 9, following. Consequently, some European airlines such as Air France, British Airways, Swissair, SAS, Iberia, Air Inter and Lufthansa may provide the required launch orders for a new 150-passenger aircraft.

As discussed earlier, airlines in other parts of the world are generally more profitable than those in North America and Europe. These airlines are, with few exceptions, smaller than those in North America and Europe. Possible launch airlines for a new 150-passenger aircraft are Indian Airlines, Indonesian-Garuda, Japan Asia Airways, Malaysia-MAS and VARIG.

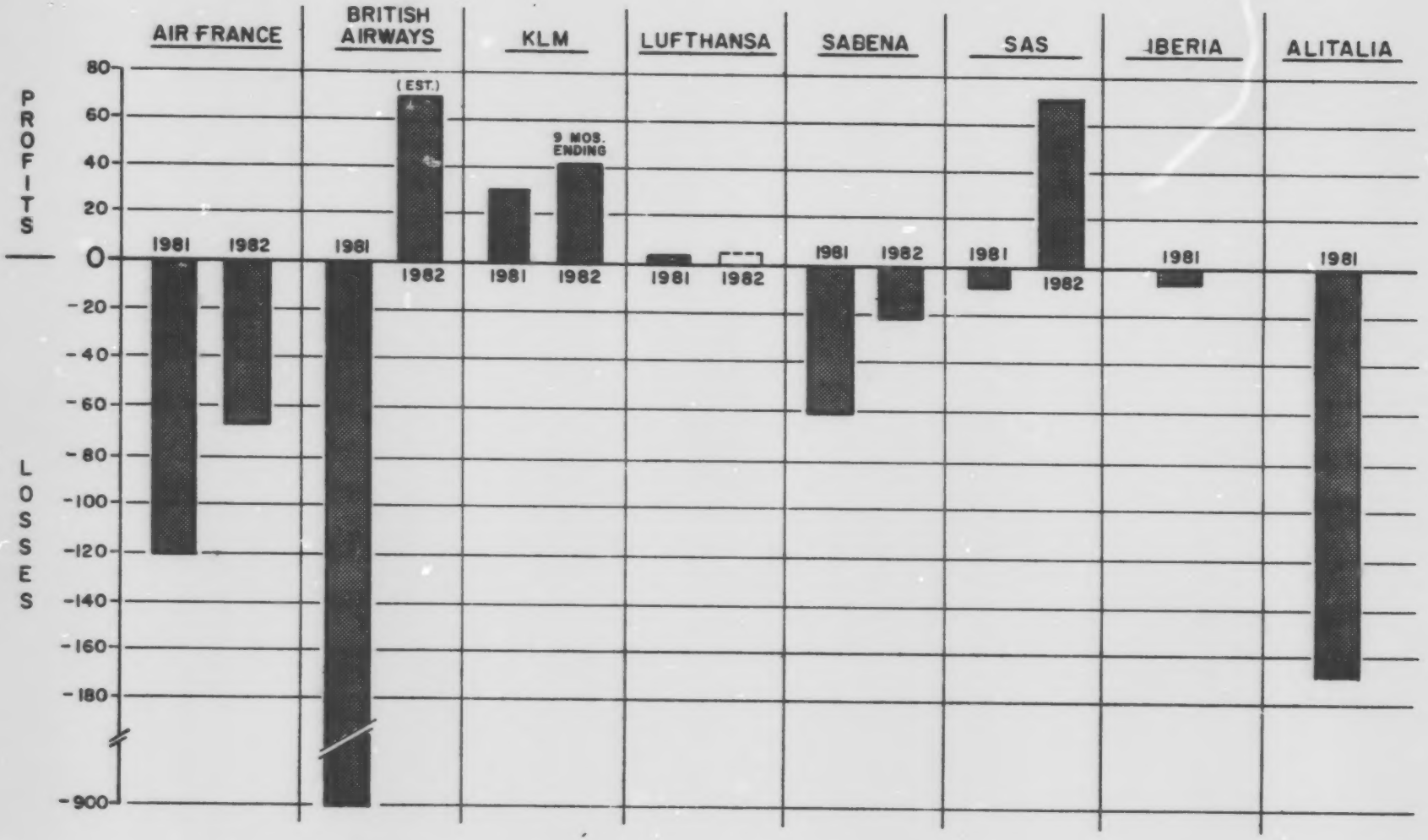
2.1.5 Summary

Airlines will need new aircraft in the future to meet air traffic growth, replace obsolete aircraft and replace aircraft that do not meet stricter noise standards. However, the ability of airlines to purchase new aircraft, as measured by profitability, is quite poor overall. Nevertheless, operating results of airlines are not uniform in all areas of the world. The 150-passenger market segment is the most active currently, and launch orders for new 150-passenger aircraft are possible, especially from non-U.S. carriers who are currently much more profitable than U.S. carriers.

EXHIBIT 9

OPERATING RESULTS* - MAJOR WORLD AIRLINES, EUROPE

(millions $ U.S.)



SOURCE: ICAO, AVIATION WEEK AND SPACE TECHNOLOGY

* BEFORE INTEREST AND TAXES

2.2 AIRFRAME INDUSTRY DEVELOPMENTS

2.2.1. The Major Competitors, 1983

The major competitors in the airframe manufacturing business are Boeing, McDonnell-Douglas and Airbus Industrie.

Boeing

Boeing is the largest civil aircraft manufacturer in the world, with headquarters in Seattle, U.S.A. The firm is publicly owned, with shares traded on major stock exchanges in the U.S. and Europe.

Boeing has a broad customer base in the world market fashioned on sales of 707's, 727's, 737's, and 747's. However, Boeing's new products, the 767 and 757, are not selling well outside North America. Boeing has, so far, managed to keep Airbus out of the U.S. market except for the Airbus sale of A300's to Eastern Airlines. With McDonnell-Douglas becoming a less potent threat, Boeing is fast gaining a dominant share of the U.S. market.

McDonnell-Douglas

McDonnell-Douglas is the third largest airframe manufacturer in the world, having lost its number two status two years ago. The firm was formed through a merger of the McDonnell Corporation and the Douglas Aircraft Company in 1967. The firm is publicly owned, with world headquarters in St. Louis, U.S.A.

McDonnell-Douglas has a broad customer base for its DC9s and DC10s. Sales, however, have been declining - particularly of the DC10 which received no orders in 1982. McDonnell-Douglas, at considerable cost, has managed to stay in the commercial aviation business with several lease deals with major airlines.

Airbus Industrie

Airbus Industrie is now the second largest airframe manufacturer in the world and has its world headquarters near Toulouse, France. Airbus Industrie is a relative newcomer to the airframe manufacturing field, having been formed in 1969. Its first product, the A300, was available in 1974.

Airbus Industrie is a partnership of European aerospace manufacturers formed with an objective of building commercial passenger jet aircraft. The partnership (voting) shares in Airbus Industrie are as follows:

- Aerospatiale (France) - 37.9%
- Deutsche Airbus (a subsidiary of Messerschmitt-Boelkow-Blohm) (Germany) - 37.9%
- British Aerospace PLC (Great Britain) - 20%
- CASA (Spain) - 4.2%

Airbus Industrie associate partners are Fokker of the Netherlands and Belairbus of Belgium.

Airbus makes major business decisions by requiring 81% of the votes cast (in proportion to partner equity position) to support the business decision. Effectively, this gives the three major partners veto power. Fokker and Belairbus have no voting rights. Fokker has indicated that it will not join Airbus as a partner (it has been offered 10%), unless the voting rules are changed to allow Fokker to have veto power.

The Airbus Industrie customer base in the world market is fashioned on sales of the A300. The customer base has expanded from 4 European airlines in 1977

to 27 airlines worldwide as of April 1982. Airbus has managed to capture from Boeing the "Silk Route", a string of countries stretching from Europe to Japan. This is very significant, since this part of the world has the highest projected passenger growth rate. Airbus managed to capture more than 50% of widebody sales world-wide in 1981 despite being virtually shut out of the U.S. market.

The intention of Airbus Industrie is to develop a large European passenger aircraft manufacturing organization that will challenge the U.S. aircraft manufacturers across the whole field of commercial aircraft manufacture.

Marketing Practices

Selling aircraft is an extremely competitive, high-stakes business. Small numbers of very expensive aircraft are sold to a small number (100-150) of potential customers. The initial sale is extremely important since subsequent orders by airlines of similar sized aircraft are usually given to the same aircraft manufacturer, reflecting the significant economies gained by maintaining fleet commonality.

Current marketing programs centre on pricing and financing terms. While the other marketing factors are important, the above two marketing factors are pivotal to all current deals. The financing aspects of marketing will be discussed later.

Some of the marketing practices of airframe manufacturers are as follows:

- provision of multimillion dollar credits for spare parts to reduce airline maintenance costs;

- the price of future aircraft on option may not be fully adjusted for inflation;

- assistance to an airline to dispose of old aircraft that the new aircraft are displacing;

- provision of credits to purchase aircraft simulators;

- commitments to pay penalties if the fuel performance of an aircraft does not match that of a competitor aircraft (e.g. a 767 vs. an A310);

- provision of promotional support allowances;

- emphasis placed on competitor product shortcomings.

Financing

Traditional relationships exist between banks and aircraft manufacturers. Boeing, McDonnell-Douglas and Airbus Industrie all have their particular links with banks, assisting in the selling of equipment and financing.

Airbus Industrie has designated certain banks as country agents. These banks are the Midland Bank (UK), the Dresdner Bank (West Germany) and Credit Lyonnais (France).

A key problem for the European banks is the maturity of loans. In the Euro-market, a major source of funds, it is uncommon to see credits of more than 10 years. A more realistic period for aircraft financing is 15 years, since the average life of many aircraft is between 10 and 20 years for the first operator.

In North America, a large part of aircraft financing is done through equipment trust financing. This is a type of mortgage in which a specially established trust owns the equipment initially and writes off the loan over time.

Some American airlines are so unprofitable that they have been unable to take advantage of Investment Tax Credits (ITC's) upon purchase of new aircraft. The Safe Harbour Leasing Act, which is due to expire at the end of 1983, has allowed airlines to sell their ITC's to profitable companies, enabling airlines to benefit from ITC's.

Often the airframe manufacturers themselves have to provide financing to financially troubled airlines. Companies like Boeing and McDonnell-Douglas have provided airlines with favourable financing through their respective finance companies. McDonnell-Douglas has even entered the leasing business with the lease of DC9-80's to American and TWA on extremely generous terms. The Airbus approach has been generally to guarantee a portion of the outstanding loan rather than provide financing itself.

Export Financing

Export financing is often provided through the export financing agencies in the countries where the airframes are constructed. The major export financing agencies involved in civil aviation sales are:

- ExIm Bank - United States;
- Hermes - West Germany;
- COFACE - France;
- ECGD (Export Credit Guarantee Department) - United Kingdom;
- ExIm Bank of Japan - Japan.

In Europe, the export financing agencies can and will provide interest rate subsidies to the designated lead banks (Dresdner Bank, Credit Lyonnais, and Midland Bank). Generally, the European export financing agencies have been more willing to provide subsidized interest rate financing deals. This is because of different philosophies the Europeans have towards export assistance. The export agencies are arms of the governments and are used as

political, economic and diplomatic tools to promote exports. European governments have stated policies of maintaining full employment and maintaining the continued existence of companies. These governments believe that their export policies help in meeting these goals. The governments also believe they will recover their export assistance subsidies through taxation of companies and individuals.

In contrast, the Canadian Export Development Corporation (EDC) is expected to make a profit. Furthermore, the EDC generally does not offer cut-rate financing but will do so only if forced by competitive pressures and if cabinet approval is obtained. This EDC practice is in sharp contrast to the U.K. ECGD which experienced a deficit of 1 billion pounds sterling in 1982.

The U.S. ExIm Bank is thought of as having an export assistance policy halfway between that of the European export credit agencies and that of the Canadian EDC.

Export credits for aircraft generally can reach up to 85% of the value of the purchase agreement. The 85% portion of an aircraft purchase loan can be a single loan or a consortium loan, with the banks in the consortium lending up to the country's percentage of value added of the aircraft. The remaining 15% can come either from the airline or from a consortium of banks at normal commercial rates. In exceptional circumstances, 100% of the export loan may be financed with concessionary assistance.

Airbus Industrie financing is shared by Germany, France and England on a 40/40/20 basis.

2.2.2 Airframe Developments

The first commercial jet aircraft was the Comet, introduced in 1952. With the introduction of the 707 and the DC8 aircraft in 1958, civil aviation entered

firmly into the jet age. Jet aircraft sales rose sharply as passenger traffic rose rapidly in the 1960's. At first, stretched versions of earlier aircraft were offered to accommodate the increased traffic volumes.

The next major development was the introduction of widebodies. The first widebody, the B747, was introduced in 1968, ushering in a new era of passenger comfort and aircraft size. By 1971, the number of widebodies increased with the introduction of the DC10 and the L1011. The entry into service of large widebody aircraft also brought in high-bypass engines - more powerful and quieter.

The next major development, which is still having wide repercussions on aircraft design today, was the rise in fuel prices triggered by the OPEC oil crisis of 1973-74. Rising fuel prices gave Airbus the break it needed to enter the market. The Airbus A300, a pioneer two-engine widebody, offered airlines substantial operating savings due to having fewer and therefore more fuel efficient engines than other widebodies. For flights that are not over water, new jet aircraft will likely have only two engines.

Rising fuel costs are also ushering in changes in the materials used in aircraft construction; efforts to reduce fuel consumption are also mandating technological advancements in propulsion systems, aerodynamics, structures, flight controls and electronic control systems.

The most popular new materials are lightweight composites of carbon fibres embedded in plastic. Initially, carbon fibre composites will be used for those parts whose failure would not result in disaster, but they potentially could be used in building as much as 70% of an airframe for commercial use by the end of this decade.

Although carbon fibres are about ten times more expensive - on a per-pound basis - than the aluminum they replace, savings in manufacturing make up the

difference. Carbon fibres can be compressed into various shapes, unlike metals which must be machined and then joined by welding or rivets.

Extensive work has gone into wing design. The result has been the development of supercritical wings - wings with higher aerodynamic lift than older wing designs. Supercritical wings are, however, much more expensive to design and build.

A new 150-seat aircraft will have to incorporate all the airframe and engine advances available today to compete in an era of high fuel prices.

The proposed A320 (150 seat) design also intends to incorporate fly-by-wire technology into the design as part of the Airbus drive to reduce the fuel consumption of the A320. Fly-by-wire technology replaces hydraulic controls of active surfaces with electric controls. This technology, which is present in some military aircraft, promises substantial weight savings but has never been applied to a commercial jet program other than to the Concorde. It is uncertain how the airlines will receive this commercially untried technology because of their concern for safety and reliability.

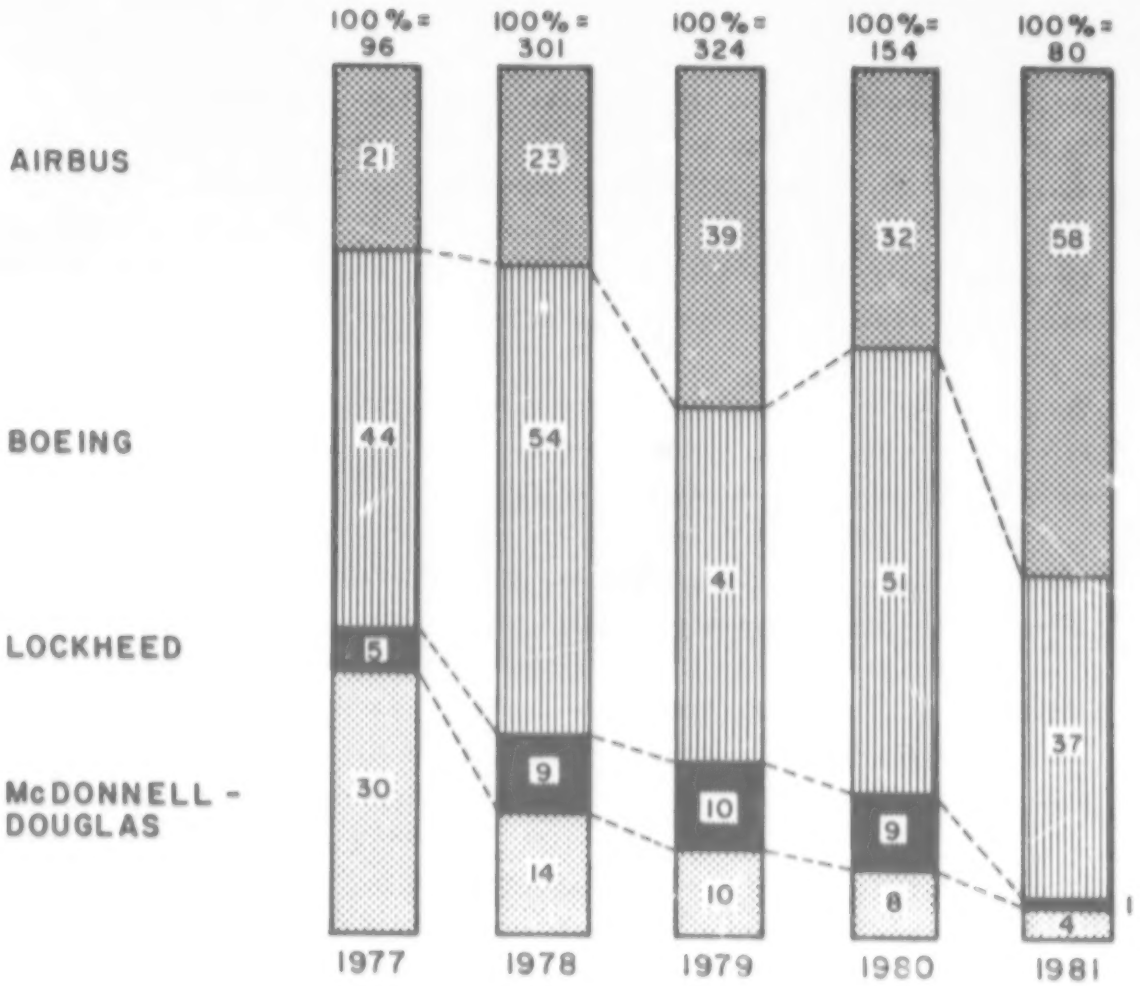
2.2.3. Competitive Trends and Market Shares

The most hotly contested market has been the market for widebody aircraft. As seen in Exhibit 10, opposite, Airbus has displaced both McDonnell-Douglas and Lockheed. Orders for both the Lockheed and McDonnell-Douglas widebodies have diminished. As a consequence, Lockheed, which had no other civil aircraft programs, decided to exit from the civil aviation business in 1982. McDonnell-Douglas has been able to stay in the civil aircraft industry only because of its DC9 program.

Airbus and Boeing are now the main contenders in the widebody aircraft market; however, McDonnell-Douglas may be able to re-establish itself in the widebody

EXHIBIT 10

MARKET SHARES OF NEW COMMERCIAL WIDE-BODY AIRCRAFT ORDERS



SOURCE: MERRILL LYNCH

market segment when DC10 sales rebound, this aircraft being the only one in its size class with over-water capability.

2.2.4 Financial Risks in the Airframe Industry

A unique combination of characteristics makes the industry a high-risk game with few winners and many losers, at least among the prime manufacturers. Unique characteristics include relatively low production volumes, large swings in production rates, high development or launch costs, long development lead times, extensive work allocation and industrial specialization, a dynamic unit cost pattern, and a uniquely difficult competitive environment. Any one of these factors would inject a high level of business risk. However, the compounding of risk when all are acting in concert, makes the industry unique.

Violent swings in aircraft demand are a norm for the industry. In 1968, 741 aircraft were delivered, yet only 3 years later, the number of aircraft delivered by all manufacturers dropped to 250.

Non-recurring costs of designing, developing and fabricating tooling for a new 150-seat aircraft are currently about $1.5 to $2 billion. This excludes the inventory manufacturing cost incurred prior to first delivery, which may be equal to the development cost. These costs represent a tremendous risk and can be recovered only through high production volumes. However, very few programs have experienced production volumes large enough over a sufficiently long time period to reduce unit non-recurring development costs per aircraft to acceptable levels.

The risks associated with market uncertainties and high development costs are accentuated by long lead times. It takes as much as 5 years from a program go-ahead to first delivery. Accordingly, it takes a long time to recover development costs.

Because of the high development costs, long development lead times, and the learning curve in production, it takes a long time and a substantial number of units for a program to become profitable. The financial investment and risk exposure is extremely high until a relatively large number of units are produced. Exhibit 11, following, illustrates the relationship of cumulative average unit cost to price as a function of units produced. While average cumulative unit costs diminishes with production volume, airplane price remains constant. Unlike military programs, the unit price of a civil aircraft model does not vary with volume except for inflationary adjustments. "Unit breakeven" occurs when sufficient units are produced to drop the cumulative average unit costs to the unit price level.

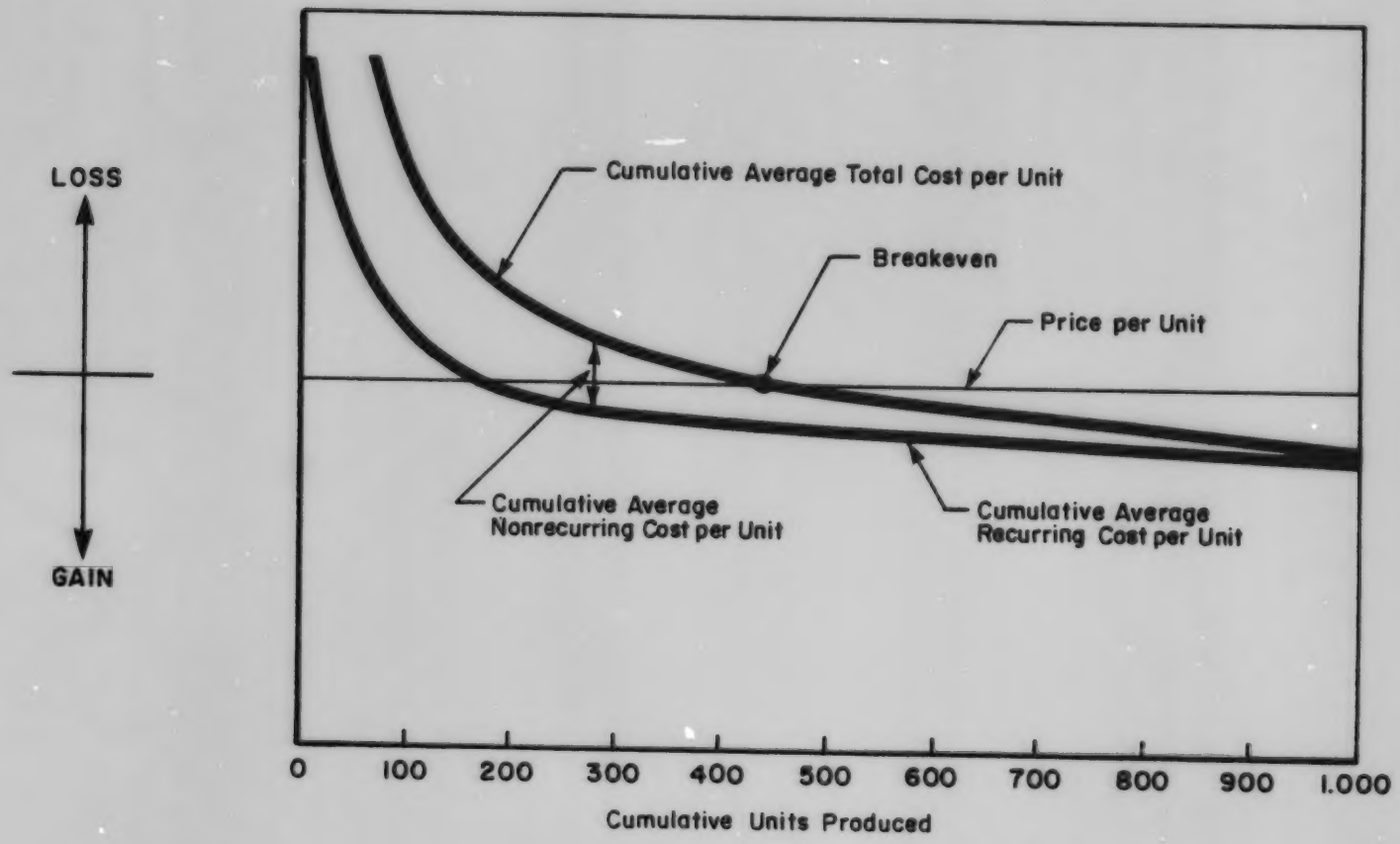
Exhibit 12, following, illustrates cumulative cash flow pattern for a typical program that is relatively successful in terms of sales quantities. The curve depicts the net investment position over time, taking into consideration non-recurring investment, recurring costs and learning curve impacts, interest costs and a fixed aircraft sales price. Note that the peak investment occurs 5 or 6 years after go-ahead, and that a cash flow breakeven does not occur until the 12th year.

Program cash flow is quite sensitive to sales volume. Sales volume drops have the effect of stretching out the time required to reach breakeven. Similarly, if a derivative program is developed, further recurring and non-recurring costs are added to the development costs, stretching out the time before a breakeven is achieved.

In summary, civil aircraft production is a high-risk business with severe market fluctuations, high investment and high sustained production requirements to attain breakeven, and strong competition.

EXHIBIT II

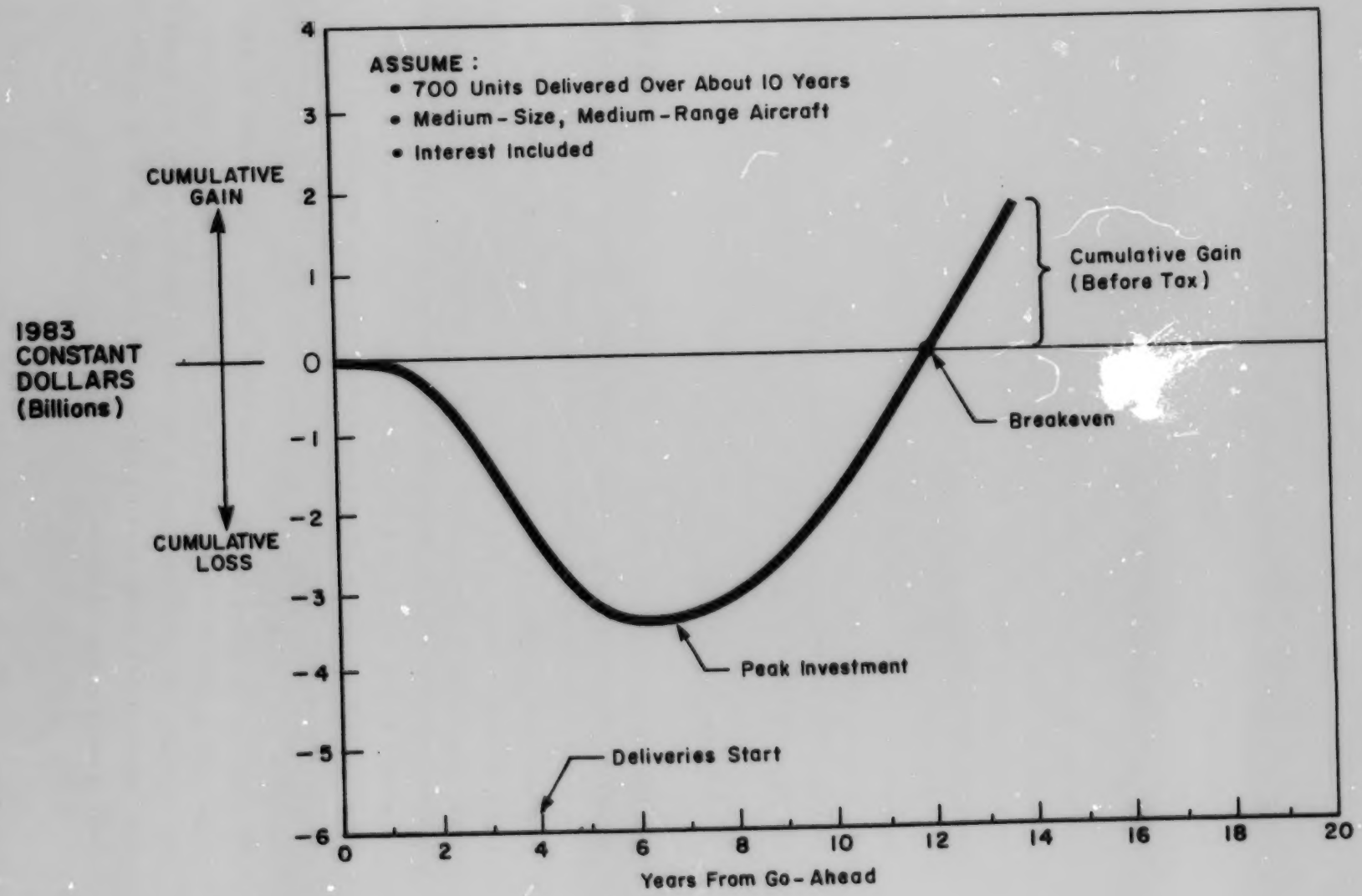
AIRPLANE PRICE VS. COST



SOURCE : BOEING

EXHIBIT 12

CUMULATIVE CASH FLOW
TYPICAL FOR A SUCCESSFUL PROGRAM



SOURCE: BOEING

2.3 AIRCRAFT ENGINE DEVELOPMENTS

2.3.1. The Major Competitors

The major jet engine manufacturers for large commercial jet aircraft are: Rolls-Royce (England); Pratt and Whitney, a division of United Technologies (U.S.A); General Electric (U.S.A.); and C.F.M. International, a 50/50 revenue sharing joint venture between General Electric and SNECMA (France).

Because of the nature of the joint venture, the complementary nature of the CFM product line, and since CFM International shares the same corporate headquarters as the engine division of General Electric, the CFM56 engine family has been included as part of the product line of General Electric.

Business Portfolios

All the engine manufacturers are in both civil and military engine businesses. Moreover, all three large engine manufacturers have military engine businesses that form at least 55% of their respective business portfolios, as seen in Exhibit 13, opposite. However, the engine businesses are not of equal importance to each company. Rolls-Royce is most dependent on the jet engine business, since this business forms 83% of the Rolls-Royce business portfolio. General Electric (GE) is the least dependent on jet engines, since engines form only 11% of the GE business portfolio. Rolls-Royce has the most vulnerable business portfolio - the company has the least diversification of any of the engine manufacturers.

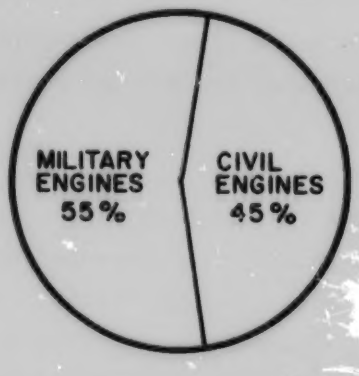
Military engine sales growth exceeds civil engine sales growth in all three companies as they all benefit from the rise in NATO defence spending. Furthermore, the profitability of the engine businesses for all three firms is low, reflecting a high level of competition and high spending on R&D to maintain product competitiveness.

EXHIBIT 13

AIRCRAFT ENGINE MANUFACTURERS BUSINESS MIX

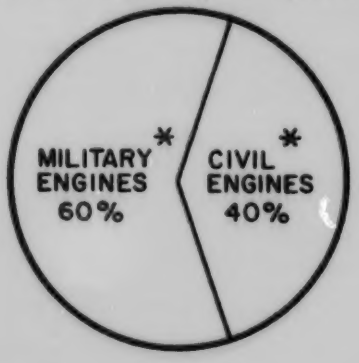
UNITED TECHNOLOGIES (PRATT & WHITNEY)

ENGINE REVENUES $U.S. 4,552 million



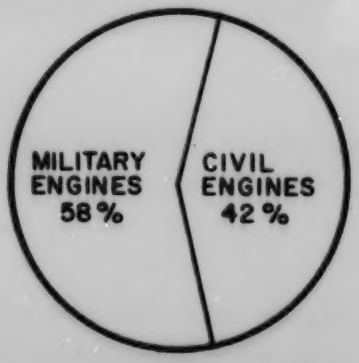
GENERAL ELECTRIC

ENGINE REVENUES $ U.S. 2,950 million



ROLLS-ROYCE

ENGINE REVENUES $ U.S. 2,460 million



CHARACTERISTICS

- ENGINES : 41% OF COMPANY SALES
- LOW PROFITABILITY
- MILITARY SALES 37% GROWTH
- CIVIL SALES 10% GROWTH

- ENGINES: 11% OF COMPANY SALES
- LOW PROFITABILITY
- MILITARY SALES >40%
- CIVIL SALES, NOMINAL REAL GROWTH

- ENGINES: 83% OF COMPANY SALES
- LOSSES IN 1981, 1980, 1979
- MILITARY SALES 21% GROWTH
- CIVIL SALES 12% GROWTH

* ESTIMATE

SOURCE: COMPANY REPORTS, PEAT MARWICK ANALYSIS.

Engine Markets

The product lines of the engine manufacturers are classified according to thrust class. Exhibit 14, following, illustrates the product coverage of each of the engine manufacturers.

The 45-60,000 lb. thrust class, which powers the wide body jets, is very well covered. The competition in this class is intense - so intense that the manufacturers are not making money in this segment. General Electric has the best position in the class, having a larger share than either Pratt and Whitney or Rolls-Royce. The engine technology in this class is very advanced.

The engines in the 30-45,000 lb. thrust class power the Boeing 757. Here too, there is fierce competition between Rolls-Royce and Pratt and Whitney. General Electric withdrew from this market segment because it felt that the market could not support three profitable engine manufacturers. The level of engine technology in this class is state-of-the-art.

Only in the 20-25,000 lb. thrust class - the engines required to power the 150-seat or smaller aircraft - is there no state-of-the-art engine. The Pratt and Whitney JT8D engine design is more than 20 years old, while the CFM56 engine is an intermediate technology high-bypass engine. The CFM56-4 engine has been chosen by Airbus to power the proposed Airbus A320. Rolls-Royce has no engine in this thrust class but has developed a state-of-the-art prototype, the RJ500, in a joint venture with the Japanese.

In the 20-25,000 lb. thrust class, both Rolls-Royce and Pratt and Whitney have product line gaps - Rolls because it has no production engine in this class and Pratt and Whitney because its engine design is more than 20 years old.

Hope for a new advanced 25,000 lb. thrust engine was heightened with the March, 1983 tentative agreement to form a consortium composed of Rolls-Royce,

EXHIBIT 14

PRODUCT MIX BY THRUST CLASS

THRUST CLASS	EXAMPLES OF AIRCRAFT	ENGINE NAME		
		ROLLS ROYCE	GENERAL ELECTRIC	PRATT & WHITNEY
45,000 - 60,000 lbs.	B767, B747, A310, A300	RB 211-22B(N) -524	CF6(N)	JT9D(N) ↓ PW4000(N)
30,000 - 45,000 lbs.	B757	RB211-535C(N)	-	PW2037(N)
20,000 - 25,000 lbs.	B727, B737, DC9	-	CFM56(I)	JT8D-200(O)
10,000 - 20,000 lbs.	F28	Tay	-	-

GENERATION N = NEW
I = INTERMEDIATE
O = OLD

Source: Rolls Royce and PMP analysis

Pratt and Whitney, Japanese Aero Engines, MTU and Fiat to design and build a new state-of-the-art engine, as advanced as the present engines in the 45-60,000 lb. and 30-45,000 lb. thrust classes. This new engine, with planned introduction in 1988-1990, would fill the product portfolio gaps of both Rolls-Royce and Pratt and Whitney.

Market Sizes Projected by the Engine Manufacturers

The major engine manufacturers are predicting that the largest engine segment (by value) will be in the 45-60,000 lb. thrust class. For example, Rolls-Royce is predicting that this class will account for 45% of the total market in 1986 and 55.5% in 1996, as illustrated in Exhibit 15, opposite. Pratt and Whitney is even more bullish for this segment, predicting that it will account for 65% of all civil aircraft engines, by value, in the period 1983-1992.

In the combined 10-25,000 lb. thrust segment, Rolls-Royce predicts a market demand varying from 17.7% to 20% of total sales, as shown in Exhibit 15, while Pratt and Whitney is more pessimistic; Pratt predicts this thrust class will account for only 11% of total engine sales by value in the period 1983-1992. Since the engine manufacturers are predicting a small market share for 20-25,000 lb. thrust engines, they are reluctant to offer new engines in this thrust class in competition with each other.

The engine manufacturers believe that only one manufacturer can be profitable selling an all-new 25,000 lb. thrust engine.

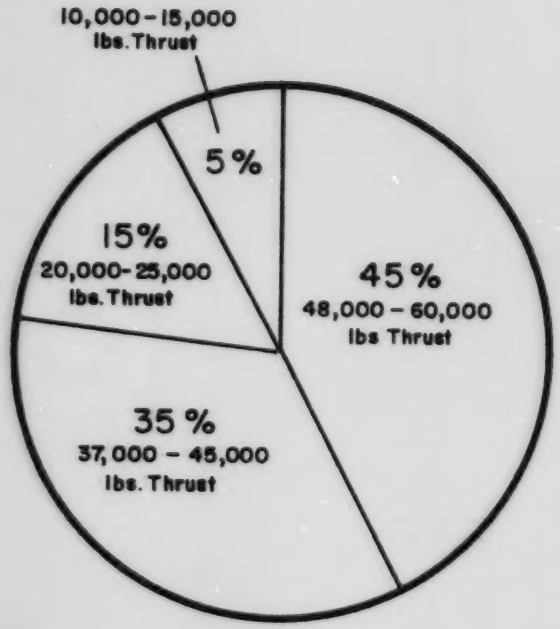
Market Shares

Given the product lines of each of the engine manufacturers, the market shares projected by Forecast Associates for the period 1982-1986 are displayed in Exhibit 16, following. Pratt and Whitney is expected to capture 36% of the total market in this period, down significantly from the 70% share Pratt and Whitney once had in the late 60s and early 70s.

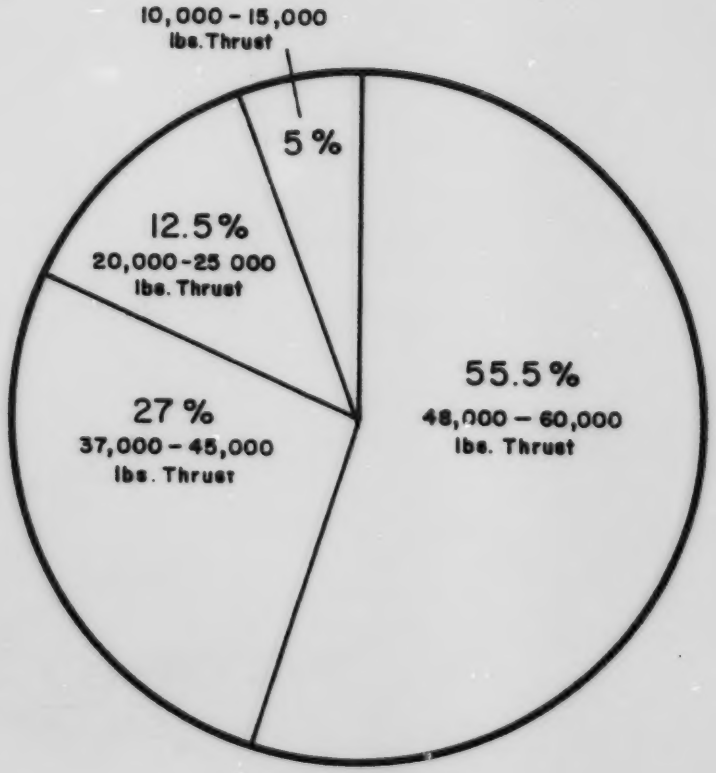
EXHIBIT 15

WORLD CIVIL JET ENGINE MARKET BY THRUST CLASS
BY VALUE OF ENGINE

1986
TOTAL MARKET
$ U.S. 2.4 Billion



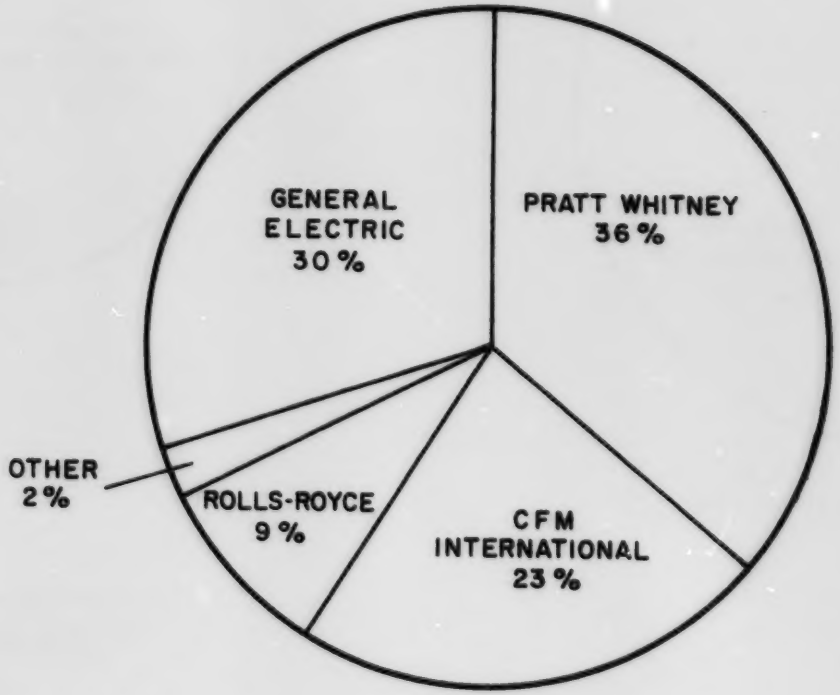
1996
TOTAL MARKET
$ U.S. 4 Billion



SOURCE: ROLLS-ROYCE

EXHIBIT 16

WORLD CIVIL JET ENGINES*
MARKET SHARE BY VALUE OF ENGINES SOLD
1982 – 1986



* DOES NOT INCLUDE SMALL ENGINES

SOURCE: FORECAST ASSOCIATES INC.

CFM is expected to gain a large share because of re-engining programs to comply with noise regulation standards which are coming into force in the mid-80s, and from projected sales of the 737-300 with CFM56-3 engines.

The strong General Electric share comes from the A300, A310 and 767 programs.

Rolls-Royce is projected to lose share of new engine sales, since it is not established on many airframes and because of the closing of the L1011 production line. Rolls-Royce is almost totally dependent on the success of the Boeing 757 which is equipped with the RB211 engines.

Engine Manufacturers - Strategies and Objectives

Pratt and Whitney see the 45,000-60,000 lb. thrust class as the major market segment. It has set an objective of regaining a dominant share of the world civil engine market. As part of this strategy, Pratt and Whitney has announced a $1.5 billion development program to develop the PW4000 engine aimed at capturing the 45-60,000 lb. thrust segment - the most lucrative market segment.

Pratt and Whitney is looking at a consortium to build a 25,000 lb. thrust engine since:

- the market is too small for more than two competitors;
- Pratt and Whitney is too over-extended, financially, to develop a new engine alone because of ongoing programs, yet does not want to lose this market segment - Pratt and Whitney want to compete in all market segments;
- the technological life of the engine may be threatened in the late 1990s by advanced turbo-props.

Rolls-Royce is presently very vulnerable. Its stated public objective is to capture a 30% share of the world market. Privately, it is hoping for a 15% market share. Since Rolls-Royce is not established on many airframes and because of its poor financial condition, its objective is to maintain the competitiveness of its RB211 program, the cornerstone of its civil jet engine program. Rolls-Royce also want to broaden its product line by building the new technology 25,000 lb. thrust engine to power a new 150 passenger airplane.

The General Electric strategy is defensive. It sees all civil engine programs as derivatives of military engines and has been unwilling to spend much money on the CFM56 engine for the proposed A320. Furthermore, General Electric is probably seeing better returns in its other businesses than in the jet engine business. Consequently, General Electric is not expected to invest substantially in a 25,000 lb. thrust engine, and thus, the level of technology incorporated in the CFM56 family of engines is unlikely to become state-of-the-art.

2.3.2 Technical Trends

In the late 1960s, high bypass ratio turbo-fan engines were introduced into the civil engine market by Pratt and Whitney with the introduction of the JT9D series. This series was followed by the General Electric CF6 and Rolls-Royce RB211 series engines in the early 1970s. The Pratt and Whitney and General Electric engine development costs were all financed by military development grants. Further developments in these large turbo-fans have been aided by NASA financed programs.

High bypass engine technology came to the 37-45,000 lb. thrust class in the late 1970s and early 1980s when engines were developed by Rolls-Royce and Pratt and Whitney for the Boeing 757.

The 20-25,000 lb. thrust class is the last major jet engine segment awaiting the development of an advanced technology, high bypass engine.

The expected benefit of high bypass technology on the fuel consumption of a new 25,000 lb. thrust engine is represented by the RJ500 or proposed consortium engine. The new engine offers substantial fuel savings over current engines as seen in Exhibit 17, following. The new engine could have a fuel consumption 12% better than the current CFM56-2 and 20% better than the current JT8D powering the DC9-Super 80.

2.3.3 Use of Fuel Efficient Engines on Derivative Aircraft

The CFM56-3 is being developed for the Boeing 737-300 while the CFM56-4 is the proposed engine for the A320. The CFM56-4 offers higher thrust and higher fuel efficiencies than the CFM56-3. The CFM56-4 also has a larger fan diameter than the CFM56-3.

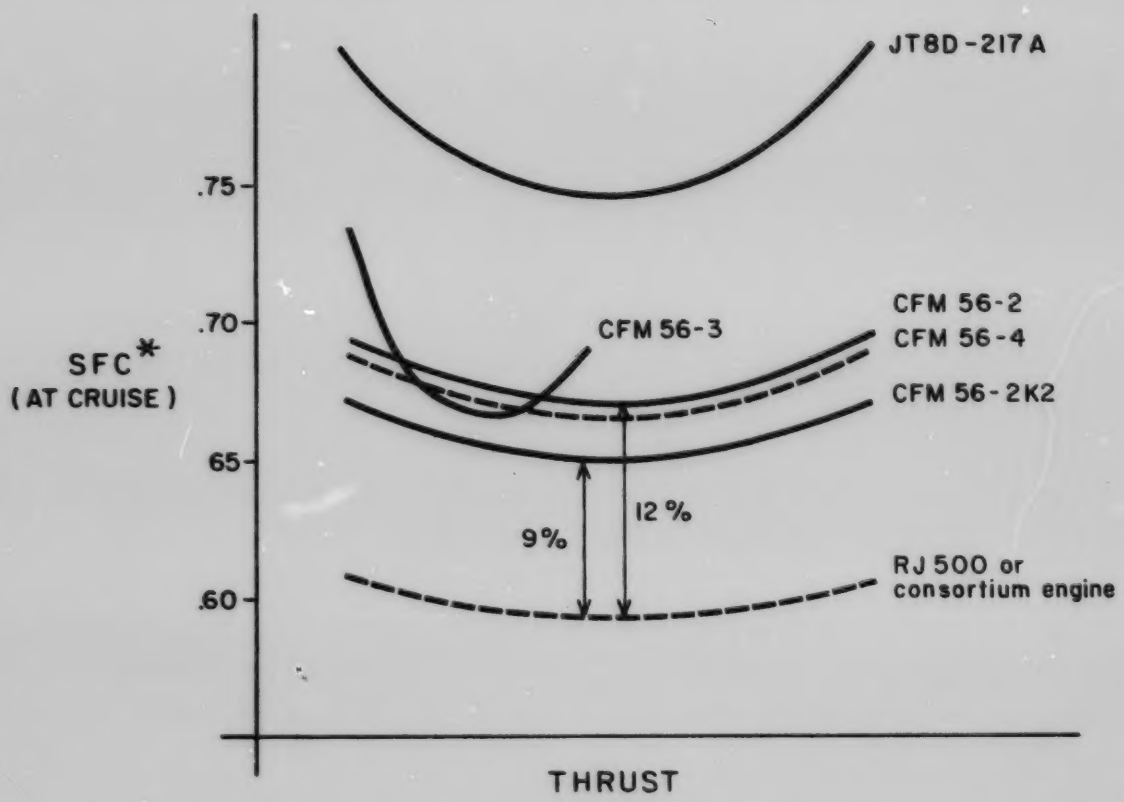
The A320 with the CFM56-4 engine offers fuel savings which cannot be easily duplicated by the DC9-Super 80 and the Boeing 737-300.

The Boeing 737-300 cannot accommodate the CFM56-4 engine since the fan diameter of this engine is too large. The Boeing 737-300 would need expensive design changes to accommodate the engine: either a new wing or a new undercarriage.

The DC9-Super 80 also cannot easily accommodate the CFM56-4 engine since the CFM56-4 engines are heavier than the Pratt and Whitney engines currently used on the DC9-Super 80 aircraft. The aircraft would need ballast in the forward section of the fuselage to offset the weight at the rear. Furthermore, the engine mountings would require redesign to accommodate the larger fan diameter of the CFM56-4 engine. Much of the fuel efficiency gained by using the CFM56-

EXHIBIT 17

SPECIFIC FUEL CONSUMPTION OF VARIOUS 20 - 25,000 lb. THRUST ENGINES



* Specific Fuel Consumption; lb of fuel per hour per lb of Thrust.

SOURCE: ROLLS-ROYCE

4 engine would be offset by the weight penalties associated with the changes to the DC9-Super 80 to accommodate the engine.

McDonnell-Douglas would prefer to use the CFM56-3 engine instead since no changes to the DC9-Super 80 fuselage would be required. Unfortunately, the CFM56-3 does not have enough thrust to power the DC9-Super 80. To increase the thrust of the CFM56-3 engine, the hot core section of the CFM56-3 engine would need extensive development work. However, the improved core of the CFM56-3 could be used in the CFM56-4 further improving the performance of this engine. The CFM56-4 would thus continue to maintain its performance advantage over the CFM56-3.

Clearly, a larger fan diameter engine would provide substantial fuel savings for a new technology aircraft that older derivative design aircraft cannot obtain.

2.3.4 Development Risks

The cost of developing a new 25,000 lb. thrust engine is estimated to be between $1.5 to $2.0 billion. Given the small market forecast for this engine, Pratt and Whitney and Rolls-Royce are unwilling to compete against each other in this market segment.

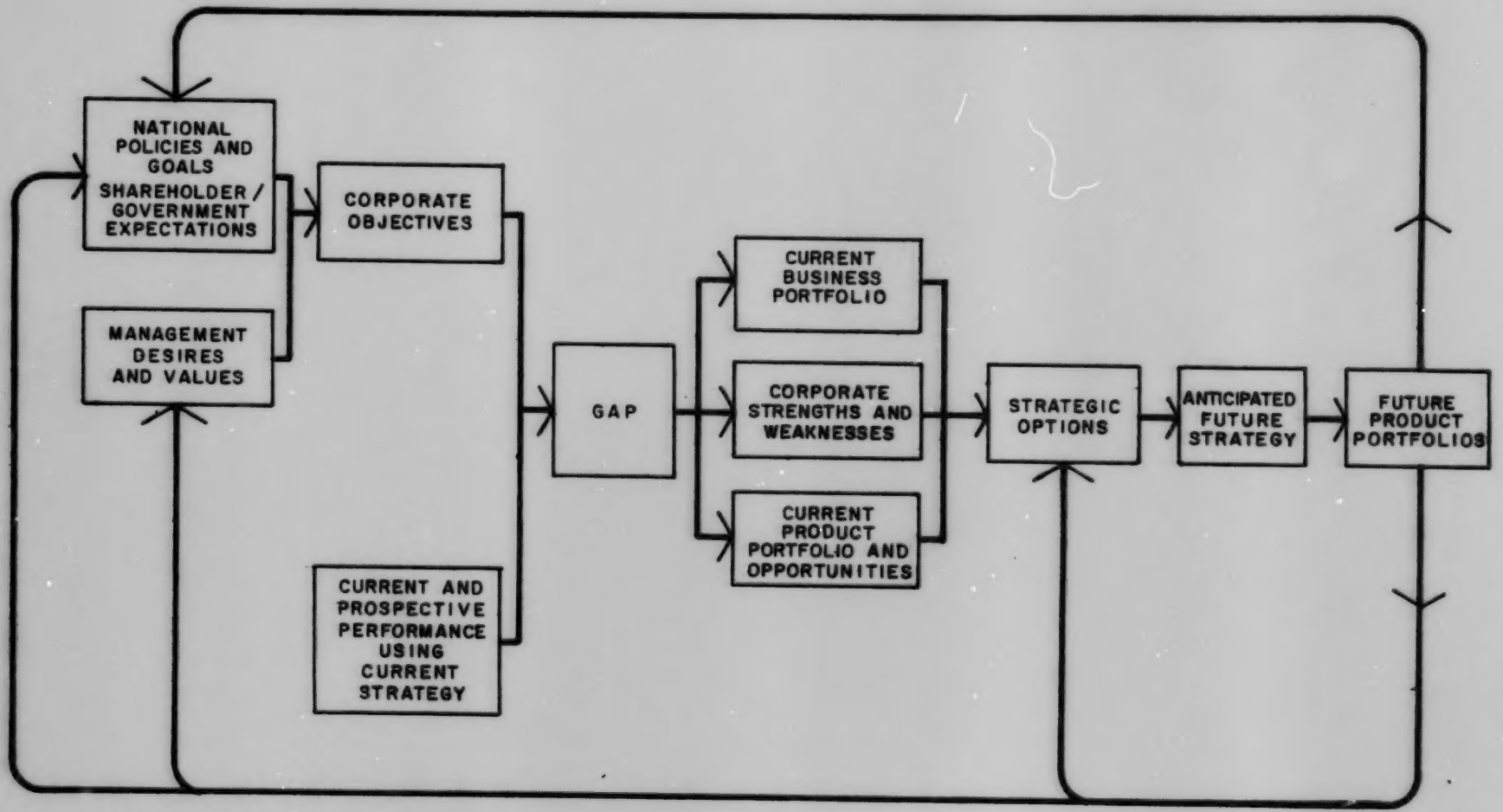
To recover the development costs, a new engine is likely to cost an airline $1 million per engine more than the price of a CFM56-4 engine, currently proposed for the A320. Because of this premium, airlines may consider that the return on investment of the new engine is insufficient to displace the CFM56-4.

2.3.5 Summary

The CFM56-4 engine is currently the best engine offered to power a new 150-seat aircraft. Pratt and Whitney and Rolls-Royce have indicated that they wish to form a new consortium to develop an advanced technology 25,000 lb. thrust engine. The economics of this new engine may be unfavourable compared to the CFM56-4 depending on fuel prices. It could happen that the CFM56-4 engine might be the only engine offered to power a new 150-seat aircraft; on the other hand a more powerful and more fuel-efficient engine may favour the overall economics of the A320, even at a higher engine price.

EXHIBIT 18

A STRATEGIC PLANNING MODEL CENTERED ON GAP ANALYSIS



3. AEROSPACE STRATEGIC ANALYSIS

In this section of the report we attempt to predict the anticipated strategies of the three major airframe manufacturers. This prediction is based on:

- our research of the market for aircraft, competition, technical developments, and other factors described earlier in this report;
- analysis of each corporation (Airbus, Boeing, and McDonnell-Douglas) based on techniques for strategy development;
- our judgement as to the most likely response of each competitor to its assessment of the strategic issues facing it in the period 1983-88.

The strategic planning model used to deduce the anticipated strategies of the airframe manufacturers is centered on gap analysis. A schematic of this model is outlined in Exhibit 18, opposite.

Each airframe manufacturer is examined in terms of:

- National Policies and Goals - those which affect corporate objectives and affect corporate strengths and weaknesses.
- Corporate Objectives - those of the overall corporation of which the airframe manufacturing operation may form a part or "business unit".
- Current Business Portfolio - the portfolio or amalgam of business units of which the airframe unit may be one.

- Current Product Portfolios and Market Opportunities - an evaluation of the product portfolio of the airframe business unit, and identification of product line gaps, market threats and market opportunities for each airframe manufacturer.

- Corporate Strengths and Weaknessess - with respect to the airframe business unit, an assessment of how each corporation would perceive its strengths and weaknesses in relation to the two other competitors.

- Current Strategic Gap and Strategic Options - an analysis of the current strategic gap of each airframe manufacturer, an assessment of the strategic positions of each manufacturer based on its strengths and weaknesses and an analysis of the feasible strategic moves of each competitor to compete in the narrow body aircraft market.

- Anticipated Strategies (1983-88) - our assessment of each corporation's strategy with respect to the airframe business unit and the development/launch of new narrow body aircraft in particular.

- Future Product Portfolio (1992) - our assessment of the product portfolio movements as a result of the anticipated strategies of each competitor.

3.1 NATIONAL ENVIRONMENTS

The aerospace industry is an extremely important industry - important to the economies of the United States and Europe. A discussion of the political environment faced by aerospace industries in the United States and Europe follows.

United States

The United States has the largest aerospace industry in the world, controlling over two-thirds of both the civil airframe and jet engine markets. The U.S. aerospace industry is a world leader in both airframe and jet engine technology. Furthermore, the aerospace industry is the largest export earner of any industrial sector in the United States.

Despite the importance of the aerospace industry, the U.S. government policy is basically one of non-intervention. This policy was clearly enunciated in a recent United States government budget document which stated, "American business should be required to compete in the market, unfettered by unnecessary government restrictions, but unaided by special government privileges". Export policy receives a low priority from the current U.S. administration. Also, the current U.S. administration believes that the provision of low-interest loans to promote the sales of American products abroad collides with sound business doctrine. The U.S. government provides concessionary financing through the Export-Import Bank, but only reluctantly, since it is forced to.

The U.S. government does not have an industrial strategy and therefore lacks a consistent policy for the aerospace industry. This can be seen in the administration policy toward the Export-Import Bank, which changes with each administration. This lack of continuity in policy makes long-range planning difficult for the major U.S. aerospace companies.

The U.S. government has no ownership position in any of the major aerospace firms. Furthermore, the U.S. government does not provide any direct support, loans or subsidies to any of the major aerospace companies for civil aircraft development: a policy which is in sharp contrast to that of the major European governments. Limited support for research and development for civil aerospace is provided through NASA. Indirect support for civil aviation programs is provided by the U.S. government through it large defence

procurements of aircraft. The development of military aircraft provides an indirect support for the development of civil aircraft, since this development supports the development of new materials and processes.

Europe

The attitude of European governments vis-a-vis the aerospace industry contrasts sharply with the attitude of the U.S. government. The European attitudes can be best examined by first looking at the government policies in each of the major European countries with large aerospace industry activities.

United Kingdom

The UK has the second largest aerospace industry in the Western world, and the British Government is committed to maintaining it in a strong position. The UK industry is technically very advanced, and is committed to retaining wing and aero-engine development and manufacturing capabilities. The government has a strong presence in the aerospace industry (owning 48% of British Aerospace Corporation and 100% of Rolls-Royce), and will continue to maintain its ownership presence in this industry. The companies are, however, plagued by low productivity, and the government is committed to improving the productivity of the labour force in these companies.

While the British aerospace industry has long had a tradition of producing commercial passenger aircraft, the government view is that the development risks associated with producing large commercial passenger aircraft are too large for the British aerospace industry to absorb on its own. Consequently, the British government views cooperation with other European aerospace manufacturers as the only viable avenue to develop new civil passenger aircraft.

The British government's position is midway between that of the French and German governments. The British government is more cautious than the French government and insists that future jet aircraft programs be commercially viable. The government is also tying financing of new projects to commercial viability. The British have been hesitant about launching the A320 since they feel that the number of orders has not been sufficient for a launch.

France

France has the third largest aerospace industry in the Western world. The French government places a high priority on developing high technology industries such as aerospace, telecommunications, computers, missiles, and nuclear reactors.

The French government's policy is to promote and strengthen the aerospace industry in order to maintain a high level of aerospace technology within France. The aerospace industry is a key industry in the French economy with technological strengths in both airframe design and in engine technology. The government has a strong presence in the aerospace industry (owning 97% of Aerospatiale and 100% of Snecma), and will continue to maintain state ownership of these companies. The government also uses the state-owned banks to help carry out its aerospace policy.

The French view themselves as leaders in aerospace technology, and are very committed to maintaining a strong European technological base in aerospace. Moreover, France tends to view the Airbus consortium as "French" despite its 38% share. The French have been the most willing of the three European partners in Airbus to assume the large development risks associated with new projects. Furthermore, the French government views employment in the aerospace sector as more important than profits, and the French are willing to maintain the aerospace industry at its current strength. Nevertheless, the French are reluctant to expand the work force of the aircraft industry because

of the high costs associated with downturns in demand. The French government commitment to maintaining stable employment can be seen at Aerospatiale where the French government is increasing its defence procurements to offset the recessionary effects on Aerospatiale.

Germany

Germany has the fourth largest aerospace industry in the Western world. Aerospace is a key industry, but unlike in England and France, the aerospace industry is privately owned. Both the aerospace companies and the German Government support a policy of promoting joint ventures with other aerospace companies in other countries as a means of keeping jobs, reducing currency outflows, and improving the technology base of German companies. As a consequence of this policy, 40% of the output of MBB, the major German aerospace company, is devoted to joint projects.

While the Government is committed to maintaining a strong aerospace sector, the level of commitment to the aerospace industry is not as strong as that in either France or the UK. Furthermore, the German policy towards investment in aerospace is the most conservative. The German government stresses that the aerospace sector should be commercially viable, and that all civil aviation programs must be based on market prospects, unlike the French who place jobs ahead of profits. This attitude also spreads to other sectors like banking. German banks do not want to be forced into financing sales to poor credit risks or into buybacks and liberal leasing deals.

The government is faced with severe budget constraints, and may temporarily reduce spending in the aerospace industry to provide more social spending. Consequently, MBB, may not receive sizeable loans to pursue new aerospace programs. Because of possible cutbacks in spending, Germany may reduce their level of participation in future Airbus programs.

The German government believes that there are better potential returns from developing a long-range 200 passenger aircraft than for a new 150-seater. The German preference is to maintain the momentum of Airbus by making sure that production and delivery schedules do not slip and by creating variants, including a stretched version rather than new airplanes. It believes Airbus should take limited risks, undertake prudent expansion, perform necessary technical upgrading of its products and maintain financial stability.

European Government Objectives

European government objectives reflect social and business objectives common to each country. These common social and business objectives are to:

- establish a financially viable European commercial airframe business that can compete on a world-wide basis;
- reduce dependence on U.S.-made aircraft and reduce currency outflows;
- diversify national aerospace company business portfolios to reduce their dependence on military programs;
- maintain steady employment in all sectors of the economy.

The establishment of Airbus Industrie reflects a consensus of these common government objectives. The European governments were willing to take a direct stake in promoting the development of a large commercial aircraft company. Airbus Industrie is a result of this consensus reached by three European governments. As a consequence of the commitment to the establishment of Airbus Industrie, these governments have been willing to lend political support to Airbus activities and have backed this support with concessionary development financing and concessionary export financing. While the European

governments are supportive of the aerospace industry, they are not necessarily supportive of the A320 at any cost.

The rise of the U.S. dollar relative to the major European currencies, if sustained, lowers the cost of the A320 launch expressed in U.S. dollars, increases the anticipated financial return of the project and therefore increases the likelihood that the Airbus partner governments will agree to the launch of the Airbus A320 aircraft.

3.2 CORPORATE OBJECTIVES

3.2.1 Airbus

The corporate objectives of Airbus put into operational reality the national objectives of the major European governments outlined earlier. The corporate objectives include the following:

- achieve, as a minimum, a 30% share of the world commercial passenger jet market;
- establish Airbus Industrie as the number 2 world producer of civil jet aircraft;
- become a full-line competitor;
- become a world leader in aircraft technology.

3.2.2 Boeing

The corporate objectives of Boeing can be described as follows:

- maintain Boeing as the leading world producer of civil jet aircraft;

- maintain market share at greater than 50% of the world commercial passenger jet market;

- provide full product coverage in all segments of the market;

- maintain Boeing's leading technical position;

- avoid financial risk by maintaining the company's traditionally conservative financial policies and in the short term, reduce the company's debt to equity ratio.

3.2.3 McDonnell-Douglas

The corporate objectives of McDonnell-Douglas include the following:

- maintain a presence in the commercial jet market for as long as possible to exploit a large single-aisle market potential:

- increase McDonnell-Douglas' share of the U.S. military business;

- diversify into other non-aviation businesses such as computer services to offset future declines in U.S. government military spending;

- maintain production facilities at Long Beach, California, to ensure the survival of several military programs that depend on that facility.

3.3 BUSINESS PORTFOLIOS

The business activities of each aerospace company can be thought of consisting of a portfolio of businesses which are strategically separable. Each of these Strategic Business Units (SBUs), are distinct businesses with different missions, concepts, competitors, technologies, markets and financial requirements.

For each aerospace company, the military and civil aviation businesses face different business environments. Demand for military products is a function of the size of a country's GNP and re-equipment requirements, and thus this demand fluctuates less than the demand for civil aircraft which is a function of changes in GNP size and the profitability of airlines. The characteristics of the civil and military jet business units, which are dominated by U.S. and European manufacturers, are summarized in Exhibit 19, opposite.

3.3.1 Airbus

The current business portfolio of Airbus Industrie is strictly limited to commercial jet aircraft. However, when the business activities of all the Airbus partners are included, the Airbus consortium is widely diversified. The business portfolio of the Airbus partners is currently as follows:

- civil aviation programs 27%;
- military programs 53%;
- helicopters 10%;
- space and other activities 10%.

The strategic assessment of the consolidated Airbus partners "current business portfolios" is shown in Exhibit 20, following. This assessment is a composite of the strategic positions deduced for the three major Airbus partners, Deutsche Airbus, Aerospatiale and British Aerospace.

EXHIBIT 19

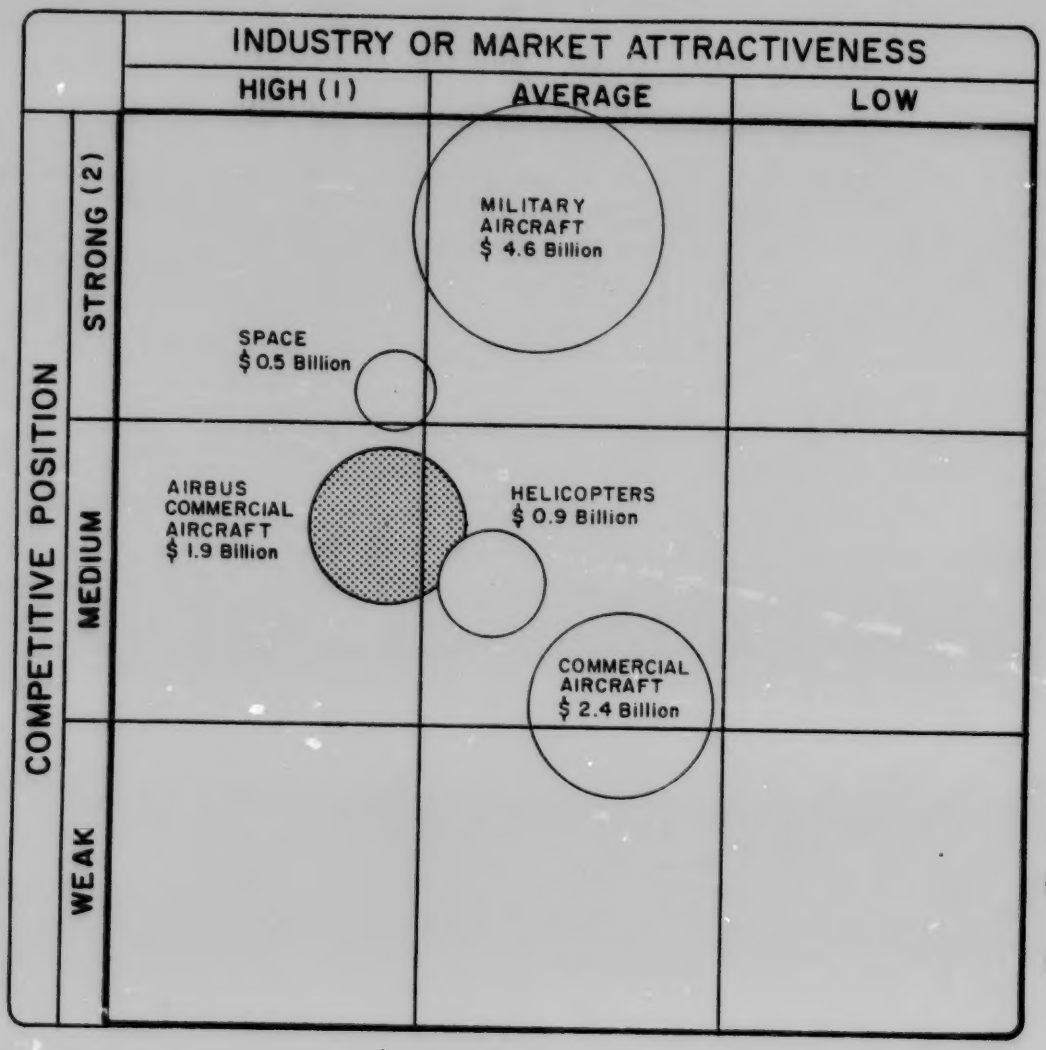
STRATEGIC BUSINESS UNIT CHARACTERISTICS

	Military Aircraft	Civil Aircraft
1. Demand (function of)	GNP size and requirement plans few customers	GNP growth and airline profitability many customers
2. Production Volumes	stable on long-term military contracts	unstable
3. Development Costs	paid by governments as incurred (payment assured)	recovered out of future sales (uncertain)
4. Financial Risk of a Project	low	high

EXHIBIT 20

STRATEGIC ASSESSMENT OF CURRENT BUSINESS PORTFOLIO

AIRBUS PARTNERS, AND AIRBUS



Average Operating Income for Fiscal Years 1980 and 1981

Circle Area Proportional to Income in $ US.

(1) e.g. High Growth Rate

(2) e.g. High Market Share

FUNDAMENTAL STRATEGIES BASED ON INDUSTRY / MARKET AND COMPETITIVE POSITION

PREMIUM OPPORTUNITY: • INVEST • CONSOLIDATE • EXPAND GEOGRAPHICALLY	**SELECTIVE INVESTMENT:** • INVEST IN SELECTED AREAS • SET SHARE OBJECTIVES • ADD NEW PRODUCTS	**PROTECT POSITION:** • INVEST FOR EARNINGS • EVALUATE LONG TERM PROSPECTS • WATCH FOR DIVESTMENT OPPORTUNITY
INVEST FOR GROWTH: • BUILD ON STRENGTHS • SECURE WEAKNESSES • SET GROWTH OBJECTIVES	**SELECTIVE INVESTMENT:** • CHOOSE SEGMENTS FOR CONCENTRATION • MONITOR COMPETITIVE THREATS	**RATIONALIZE:** • LIMIT INVESTMENT • POSITION FOR DIVESTMENT • SHIFT INTO MORE ATTRACTIVE SEGMENT
BE OPPORTUNISTIC: • RIDE MARKET • EXPLOIT EXISTING SPECIALIZATION • ACQUIRE	**PLAN FOR HARVEST:** • MAINTAIN PROFITS • LOOK FOR DIVESTMENT	**HARVEST OR DIVEST:** • LIMIT PRODUCTS • EXIT FROM THE BUSINESS IN TIME

SOURCE: Airbus Industrie, British Aerospace, Aerospatiale and MBB Annual Reports

Airbus Industrie, viewed as a single purpose partnership, has a (single) business portfolio - commercial aircraft - also shown in Exhibit 20.

This analysis surfaces a number of strategic issues:

- viewed as a "flow-through" business operated by four aerospace companies, Airbus has resources in comparable strategic positions to Boeing and McDonnell-Douglas;

- commercial aircraft (the consolidated business of the Airbus partners) is by no means the most attractive, or largest business unit of its partners;

- Airbus, as a commercial aircraft business unit, is more attractive (strong competitive position and more attractive market) than the individual commercial aircraft business units of its partners.

Airbus Industrie accounts for about 60% of the revenues of the civil aircraft businesses of its partners. The non-Airbus civil aviation programs of the partners are primarily related to the production of small aircraft for the commuter aircraft market. These activities can be summarized as follows:

- MBB - production of components under contract for Fokker of the Netherlands for its F27 and F28 programs;

- Aerospatiale - development of the ATR commuter aircraft;

- BAC - development of the BA146 small commuter jet aircraft.

Airbus Industrie has not yet reached a break-even point for any of its jet aircraft programs. Furthermore, Airbus Industrie is believed to be losing approximately $100 million per year (based on industry sources - official data not available). The cash flow shortfall of Airbus Industrie is probably much larger than $100 million because of expanding A300 production and the A310 introduction. Cash flows would continue to be negative because of the required investments to expand A310 production and because of development work related to the A300-600 and A310-300 derivatives. The negative cash flows arising from the Airbus Industrie program are being met through direct contributions through governments and by positive cash flows generated by the military and space businesses of each of the Airbus partners.

3.3.2 Boeing

Boeing has a diversified business portfolio with the highest emphasis on civil aviation programs of any of the civil aircraft companies. The current business portfolio is as follows:

- commercial transport 76%;
- military transport 13%;
- missiles and space 6%;
- other 5%.

Historically, Boeing has performed better than the aerospace industry median, and better than McDonnell-Douglas in the following: return on equity, return on total capital, average sales growth and EPS growth, as seen in Exhibit 21, opposite. Furthermore, Boeing has maintained a conservative financial policy and has a lower debt/equity ratio than the aerospace industry median. However, Boeing's performance has deteriorated since 1980, and Boeing's current return on equity and return on total capital are both below the aerospace industry median performance.

EXHIBIT 21

MANAGEMENT PERFORMANCE
AEROSPACE AND DEFENCE
1982

Company	RETURN ON EQUITY 5-Yr Average	RETURN ON EQUITY Latest 12 Months	RETURN ON TOTAL CAPITAL 5-Yr Average	RETURN ON TOTAL CAPITAL Latest 12 Months	Debt/Equity Ratio	Sales 5-Yr Average Growth	Earnings Per Share 5-Yr Average Growth
Boeing	24.9%	11.2%	21.2%	8.3%	.1	17.4%	35.2%
McDonnell-Douglas	12.5	11.2	12.4	11.0	.1	13.1	9.0%
Industry Median	17.7	11.4	13.3	10.2	.3	14.0	12.1
All Industry Medians	15.9	12.7	11.0	9.3	.4	13.3	12.3

Source: Forbes, Jan 3/83

Footnote: Last 5 years are years to and including 1982.

Boeing's financial performance deteriorated because of a steep drop in the profitability of the commercial aircraft business between 1980 and 1982, as seen in Exhibit 22, opposite. Military programs have, however, been quite profitable and are enjoying high growth rates (23.9% per year), offsetting much of the profit decline in the commercial aircraft business. The missiles and space business is also providing significant profits.

The strategic assessment of the Boeing business portfolio is shown in Exhibit 23, following. This assessment surfaces a number of strategic issues:

- the commercial aircraft business is the largest business unit and is in a strong competitive position;

- the military aircraft business is the most attractive Strategic Business Unit (SBU) currently, but accounts for a small part of the total business portfolio.

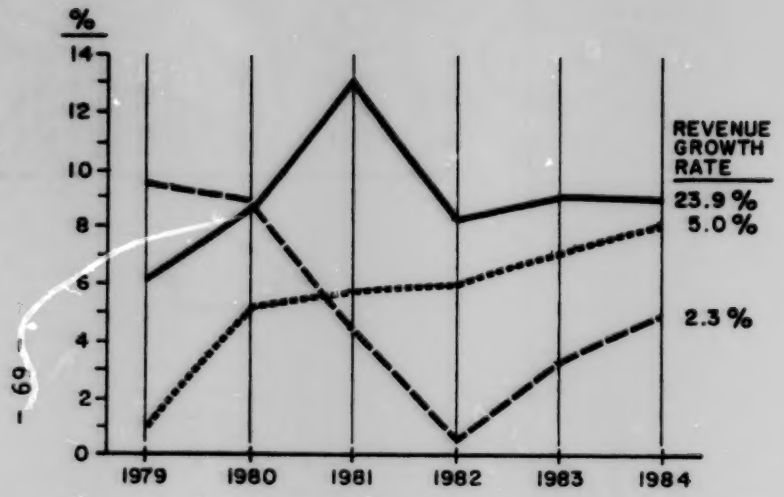
Because of high U.S. defence spending, Boeing will attempt to ride the growth in military sales in the 1980's without becoming too dependent on these sales. By 1985, military aircraft should form 22% of the Boeing business portfolio, while the commercial aircraft share should fall to 65%. Nevertheless, Boeing will still remain predominantly a commercial aircraft company.

Military programs are attractive because of the large positive cash flows that they provide to other strategic business units. The commercial aircraft business unit is currently draining cash because of the introduction of new commercial aircraft and derivatives of older aircraft. Because of a downturn in both aircraft orders and deliveries, the commercial aircraft business is providing insufficient cashflow to fund new development. Because of these new aircraft development programs, Boeing is projected to have a cash requirement of $260 million in 1983.

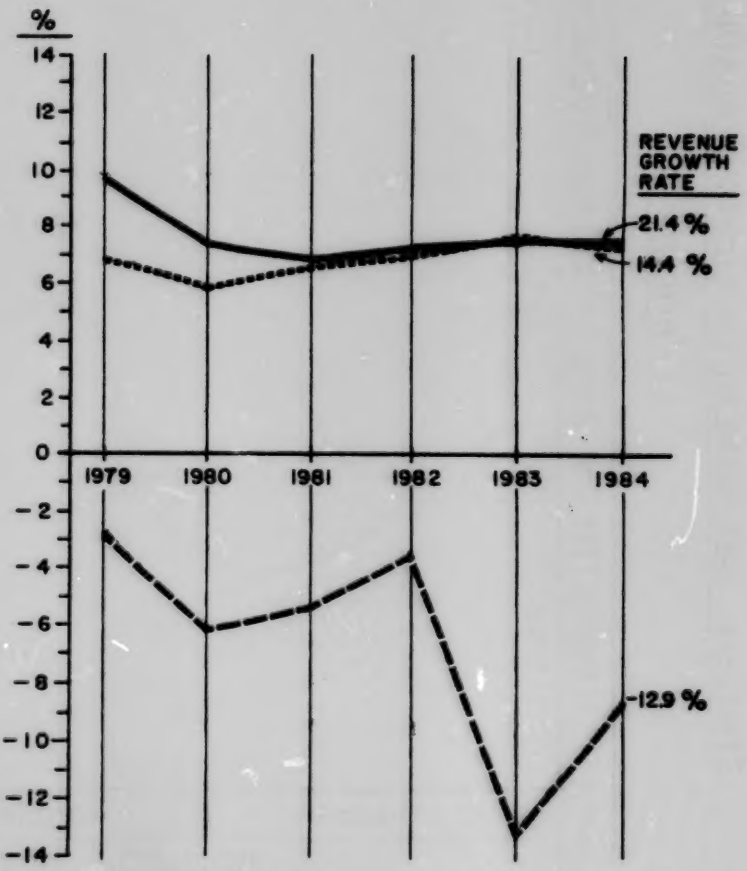
EXHIBIT 22

PROFITS AS A PERCENTAGE OF REVENUES

BOEING



McDONNELL-DOUGLAS



LEGEND

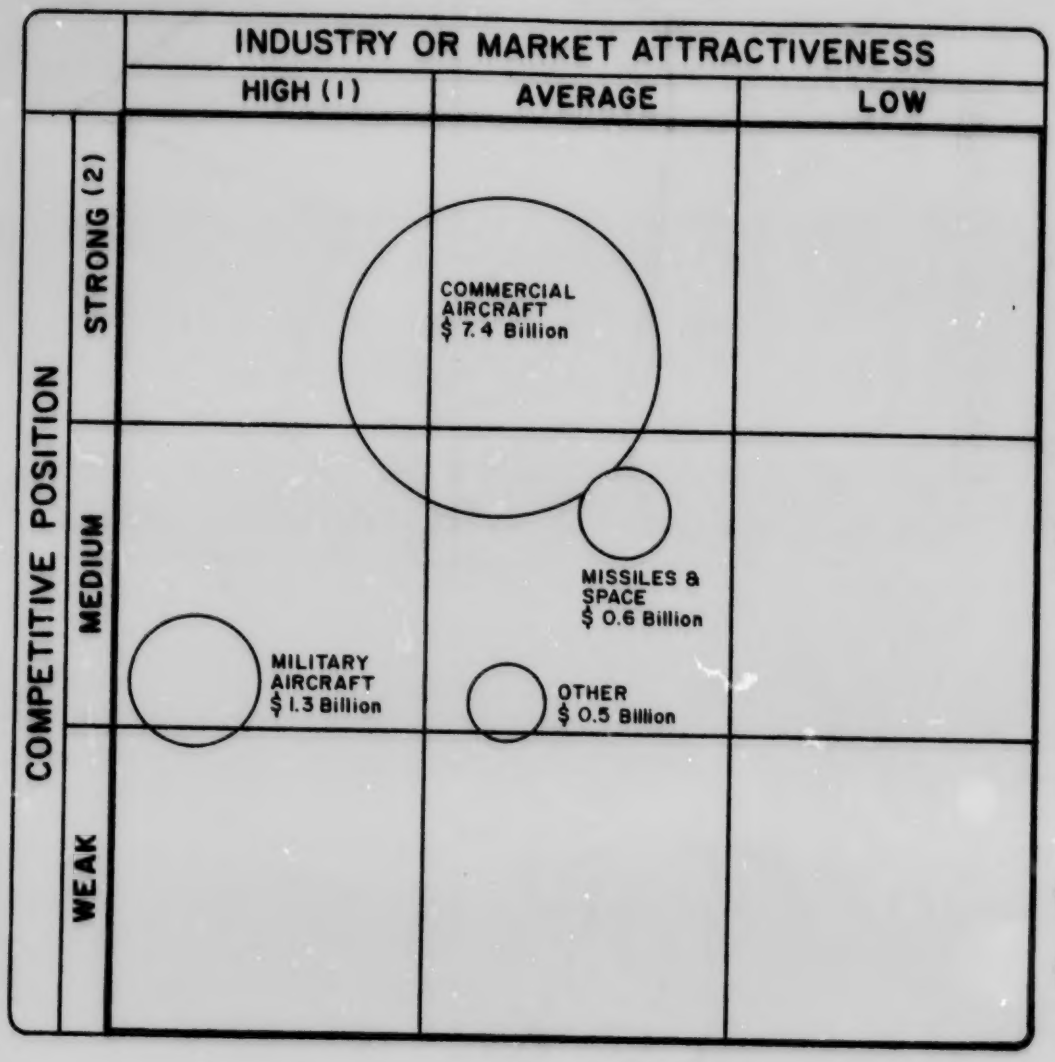
- MILITARY AIRCRAFT
- COMMERCIAL AIRCRAFT
- MISSILES & SPACE

SOURCE: Cyrus J. Lawrence, Bache Halsey Stuart, Peat Marwick Analysis

EXHIBIT 23

STRATEGIC ASSESSMENT OF CURRENT BUSINESS PORTFOLIO

BOEING



Average Operating Income for Fiscal Years 1980 and 1981

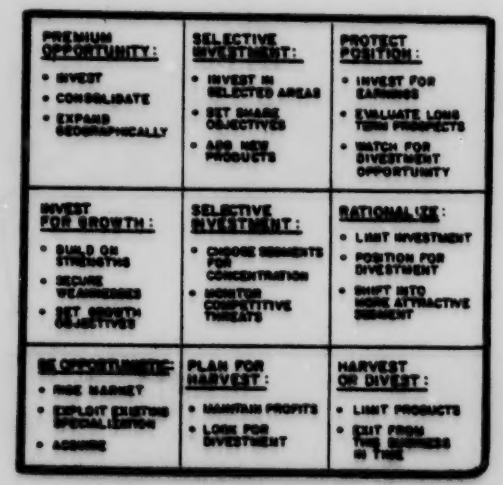
—

Circle Area Proportional to Income in $ US.

(1) e.g. High Growth Rate

(2) e.g. High Market Share

FUNDAMENTAL STRATEGIES BASED ON INDUSTRY / MARKET AND COMPETITIVE POSITION



SOURCE: Boeing Annual Report

By 1984, the development programs for the 767 and 757 should have passed their peak requirements for cash, and increased demand for military products should allow Boeing to start repaying its debt in 1984, allowing the company to improve its debt-equity ratio. The projected positive cash flows generated by all businesses should allow Boeing to rapidly increase its additional debt capacity after 1983, as shown in Exhibit 24, overleaf.

3.3.3 McDonnell-Douglas

The current business portfolio of McDonnell-Douglas is diversified, with a strong bias towards military aircraft. The current McDonnell-Douglas business portfolio is as follows:

- military aircraft 47%;
- commercial aircraft 34%;
- missiles and space 13%;
- other 6%.

Historically, McDonnell-Douglas has had a poorer financial performance than the industry median as seen in Exhibit 21, primarily because of the poor performance of its commercial aircraft business, as seen in Exhibit 22. The strong revenue growth of the military aircraft business unit (21.4% per year), together with the high profitability of the military aircraft business, has allowed McDonnell-Douglas' financial performance to improve in the last 12 months. The financial performance of McDonnell-Douglas is now close to the median financial performance of the aerospace industry.

The financial policies of McDonnell-Douglas are conservative. The debt/equity ratio for the company is below the aerospace industry median.

EXHIBIT 24

PROJECTED FINANCIAL CAPACITY OF BOEING AND McDONNELL-DOUGLAS

McDONNELL-DOUGLAS

	1983	1984	1985	1986	1987
Borrowing Requirements	383	206	122	(96)	(156)
Additional Debt Capacity	537	462	506	807	1203

BOEING

	1983	1984	1985	1986	1987
Borrowing Requirements	260	(60)	(215)	(149)	(192)
Additional Debt Capacity	754	953	1318	1624	2022

Source: Peat Marwick Analysis

The strategic assessment of the McDonnell-Douglas business portfolio is shown in Exhibit 25, following. This assessment raises a number of strategic issues:

- military aircraft, missiles and space and other business units are clearly much more attractive than the commercial aircraft business;

- the commercial aircraft business unit is moving towards the "harvest or divest" sector of the matrix.

Because of high U.S. defence spending, McDonnell-Douglas will attempt to ride the growth in defence spending. By 1984, military aircraft should form 62% of the McDonnell-Douglas business portfolio, while the commercial aircraft share should fall to 13%. The strong bias of McDonnell-Douglas to defence-related businesses will intensify.

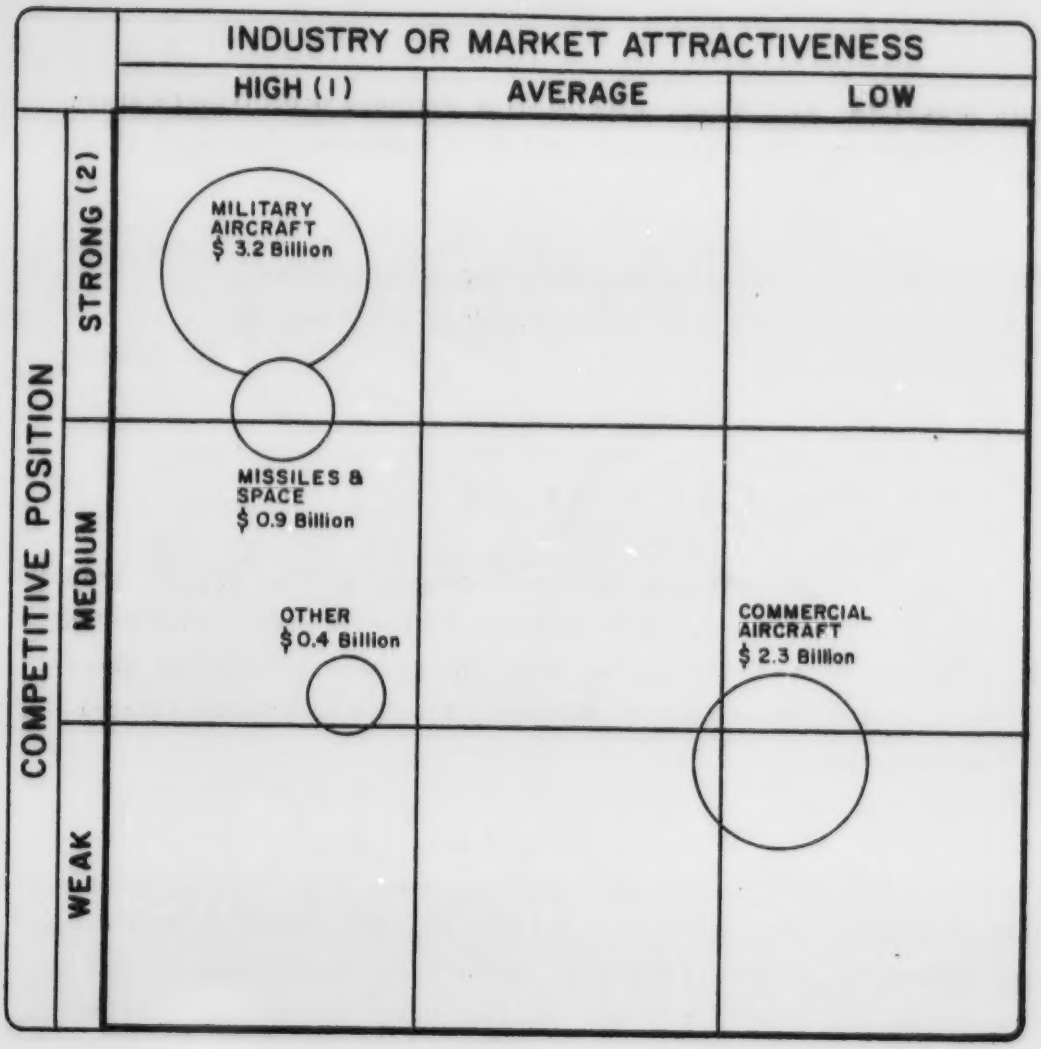
McDonnell-Douglas would normally have a balanced business portfolio. The military aircraft, and missiles and space businesses are both enjoying high profitability and high growth, as seen in Exhibit 22, and are providing substantial cash flows that can be invested in the other business units. However, the commercial aircraft business has been quite unprofitable and has considerable cash requirements.

It appears that the commercial aircraft business unit was faced with a harvest or divest decision. McDonnell-Douglas appears to have made a strategic decision in mid-1982 to remain in the commercial aircraft business. To do so, and in the adverse economic climate of 1982, McDonnell-Douglas entered into several expensive lease agreements to allow the continued production of DC9 aircraft. Consequently, the borrowing requirements of McDonnell-Douglas are expected to be substantial, reducing the company's debt capacity. The forecast cash requirements and additional debt capacity calculated using a debt-

EXHIBIT 25

STRATEGIC ASSESSMENT OF CURRENT BUSINESS PORTFOLIO

McDONNELL DOUGLAS



Average Operating Income for Fiscal Years 1980 and 1981

—

Circle Area Proportion to Income in $ US.

(1) e.g. High Growth Rate

(2) e.g. High Market Share

FUNDAMENTAL STRATEGIES BASED ON INDUSTRY / MARKET AND COMPETITIVE POSITION

PREMIUM OPPORTUNITY: • INVEST • CONSOLIDATE • EXPAND GEOGRAPHICALLY	**SELECTIVE INVESTMENT:** • INVEST IN SELECTED AREAS • SET SHARE OBJECTIVES • ADD NEW PRODUCTS	**PROTECT POSITION:** • INVEST FOR EARNINGS • EVALUATE LONG TERM PROSPECTS • WATCH FOR DIVESTMENT OPPORTUNITY
INVEST FOR GROWTH: • BUILD ON STRENGTHS • SECURE WEAKNESSES • SET GROWTH OBJECTIVES	**SELECTIVE INVESTMENT:** • CHOOSE SEGMENTS FOR CONCENTRATION • MONITOR COMPETITIVE THREATS	**RATIONALIZE:** • LIMIT INVESTMENT • POSITION FOR DIVESTMENT • SHIFT INTO MORE ATTRACTIVE SEGMENT
BE OPPORTUNISTIC: • RIDE MARKET • EXPLOIT EXISTING SPECIALIZATION • ACQUIRE	**PLAN FOR HARVEST:** • MAINTAIN PROFITS • LOOK FOR DIVESTMENT	**HARVEST OR DIVEST:** • LIMIT PRODUCTS • EXIT FROM THIS BUSINESS IN TIME

SOURCE: McDonnell-Douglas Annual Report

equity ratio of 50% is shown in Exhibit 24. This forecast shows that debt capacity of McDonnell-Douglas will remain low for the next three years and will probably be insufficient to develop an all-new aircraft.

3.4 CURRENT PRODUCT PORTFOLIOS AND MARKET OPPORTUNITIES

3.4.1 Product Line Coverage and Gaps

The current product lines of Airbus, Boeing, and McDonnell-Douglas are shown competitively according to the passenger capacity and range of each of the competitor aircraft in Exhibit 26, following. The forecast delivery requirements for 1982-2000 (as provided by Airbus) for each of the aircraft segments is also shown in this Exhibit.

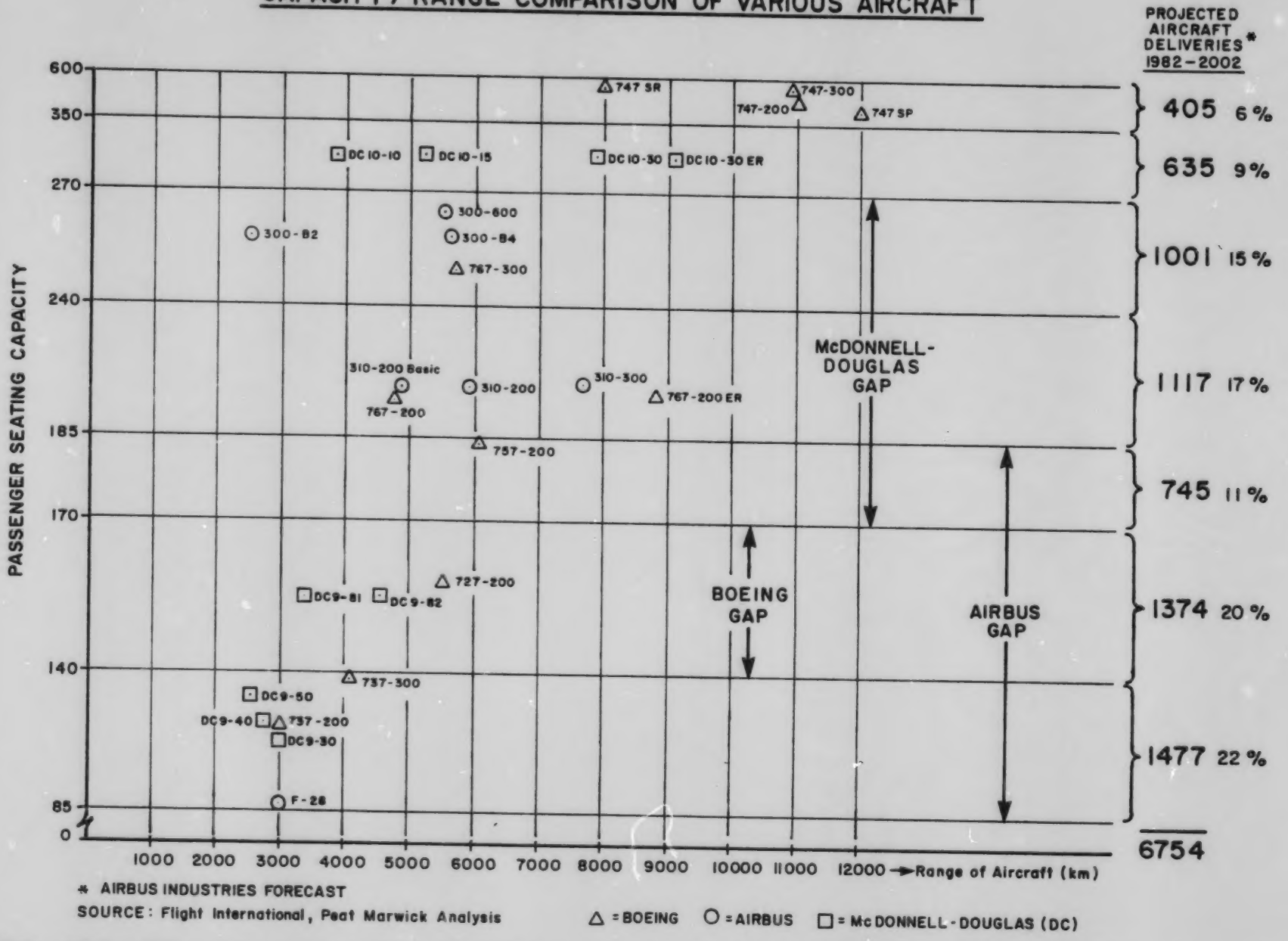
Boeing has the widest market coverage of any of the aircraft manufacturers. Boeing, nevertheless, has a gap in its market coverage caused by the discontinuation of the 727-200. Boeing hopes that its 737 (-200 and -300) and the 757 will meet any requirements in the broader 100-200 seat segment and fill the Boeing gap created by the discontinuation of the 727-200.

Airbus has product line gaps for aircraft with passenger capacities less than 200 and greater than 270. The largest unfilled opportunity, the Airbus gap, is for airplanes with passenger seating capacities below 200 seats. According to Airbus, as many as 3,596 aircraft with seating capacity less than 200 will be delivered in the period 1982-2000.

McDonnell-Douglas has product line gaps for aircraft with passenger capacities between 170 and 270 and for aircraft with passenger capacities greater than 350. The largest unfilled opportunity, the McDonnell-Douglas gap, is for airplanes with passenger capacities between 170 and 270 which, according to the Airbus Industrie forecast, will represent 43% of the projected deliveries in the period 1982-2000.

EXHIBIT 26

CAPACITY / RANGE COMPARISON OF VARIOUS AIRCRAFT



* AIRBUS INDUSTRIES FORECAST

SOURCE: Flight International, Peat Marwick Analysis

△ = BOEING ○ = AIRBUS □ = McDONNELL-DOUGLAS (DC)

3.4.2 Current Product Portfolios for Each Aerospace Company

A product portfolio chart indicates the competitive standing of each product and its expected future direction in a company's business portfolio. The product portfolio for each of the aircraft manufacturer's civil aircraft business units is provided in Exhibit 27, overleaf.

Airbus

Some observations of the Airbus product portfolio are as follows:

- The A300 is currently dominant in its market segment;
- The A300 is likely providing modest positive cash flows, but these flows are not sufficient to meet the cash requirements related to the introduction of the A310;
- A300 sales are somewhat threatened by the introduction of the Boeing 767;
- A300 sales are also threatened by Airbus' own product: the A310 - many Airbus customers are expressing interest in trading in A300s for A310s. Also, most new orders are for A310 aircraft rather than for A300s;

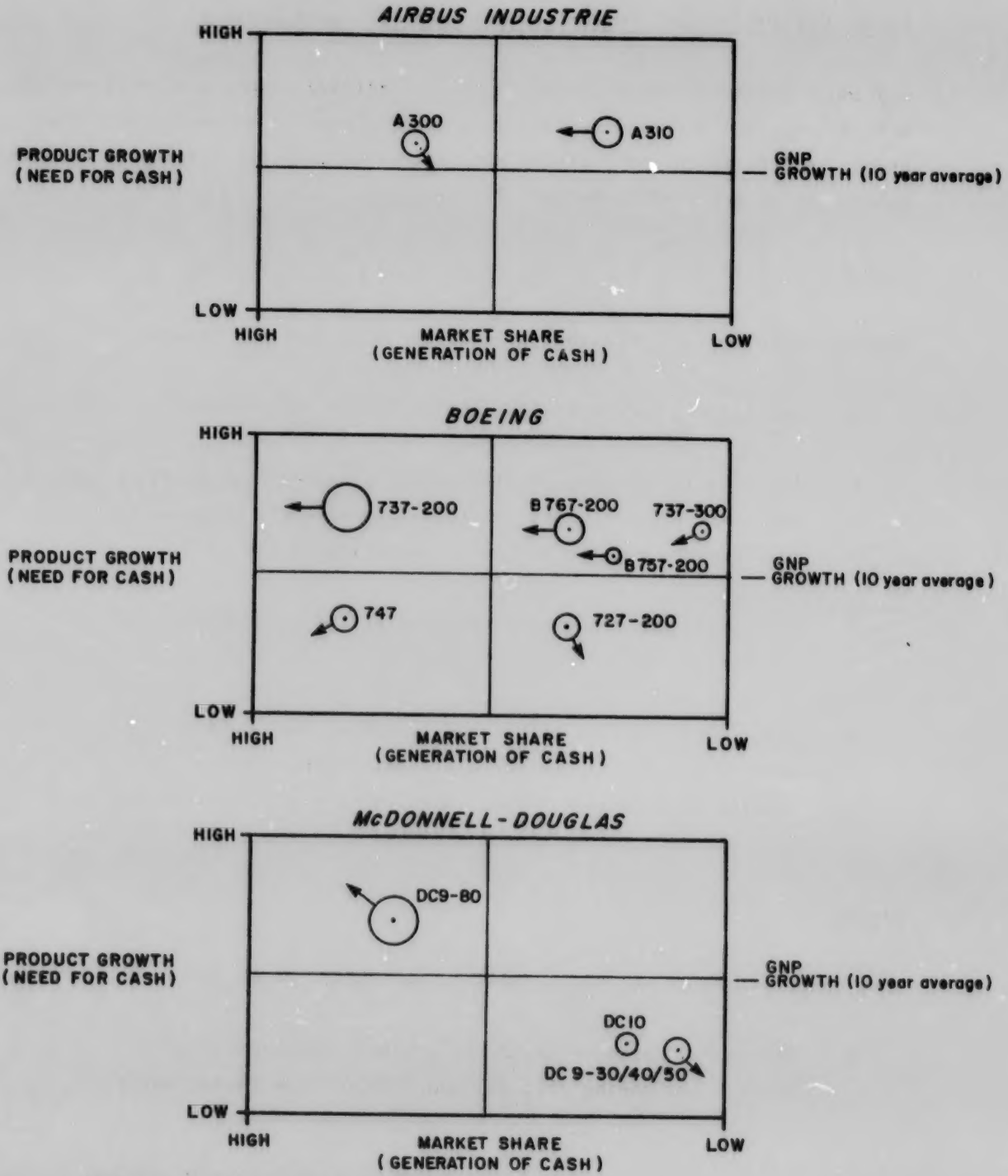
Boeing

Some observations of the Boeing product portfolio are as follows:

- Boeing had recently three new aircraft development programs: the Boeing 757, 767 and 737-300 (the latter being

EXHIBIT 27

CURRENT (1982) PRODUCT PORTFOLIOS AND INDICATED FUTURE DIRECTION



MARKET SHARE : Market Share Relative to the Market

PRODUCT GROWTH: Annual Rate in Constant Dollars Relative to GNP Growth

a derivative only). All three development programs required large net inflows of cash;

- The cash generated by 737-200, 747 and 727 jet aircraft programs has not been sufficient to off-set cash outflows required for the new aircraft development programs. Furthermore, sales of the 747 are declining, and those of the 727 have been discontinued; this reduces the cashflow generated by these programs so that Boeing will depend heavily on cash generated by the new aircraft types;

- The Boeing 737-200 is rapidly gaining a dominant position in the smaller jet passenger aircraft segment, displacing the McDonnell-Douglas DC9-30/40/50 aircraft;

McDonnell-Douglas

Some observations of the McDonnell-Douglas product portfolio are as follows:

- The McDonnell-Douglas portfolio is not in balance since DC10 and DC9-30/40/50 sales have provided insufficient cash flows to finance development of the DC9-80 derivatives and the production build-up;

- The DC9 series is targeted at the largest market segment in the period 1982-2000;

- The DC9-80 is gaining a strong position in the 150-passenger market due to the exit of the Boeing 727 and because of aggressive pricing and the lease deals entered into by the company;

- The market share of the DC9-30/40/50 series is reduced by the Boeing 737 series;

- The DC10 presently has no airline orders but this production line will be kept open with the KC-10 military tanker version of the DC10. It is expected that DC10 orders will eventually pick up, since it is the only aircraft in its size category with overwater capacity.

3.4.3 Current Product Portfolios for Each Aircraft Capacity/Range Segment by World Market

To simplify the portfolio analysis by capacity/range segments by world market, the capacity/range segments can be divided into three segments. These segments are single-aisle aircraft (100-185 passenger capacity), twin-aisle twin engine aircraft (185-270 passenger capacity) and twin-aisle multi-engine aircraft (270+ passenger capacity). The product portfolios for each capacity range segment and for each world geographic region are provided in Exhibit 28, opposite.

Single-Aisle Aircraft

Some observations of the single-aisle aircraft segment are as follows:

- The Boeing 727 aircraft will no longer be produced after 1983. The DC9-80 series will be the only aircraft competing in the 140-170 passenger market segment;

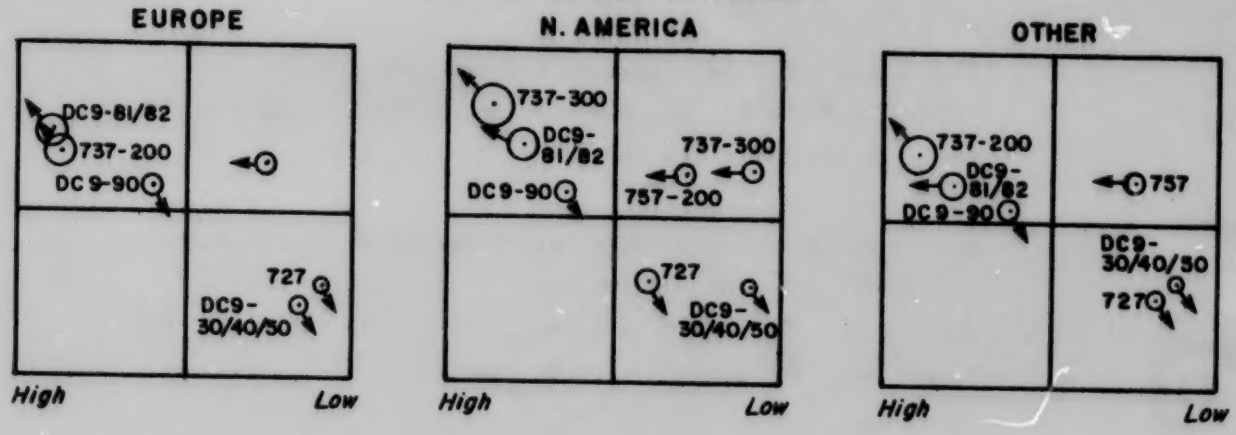
- The introduction of a new 150-seater aircraft by Boeing incorporating the latest technology would reduce the sales potential of both the 737-300 and the 757, and it would require yet more cash inflows. Any cash generated by a new

EXHIBIT 28

CURRENT (1982) PRODUCT PORTFOLIOS

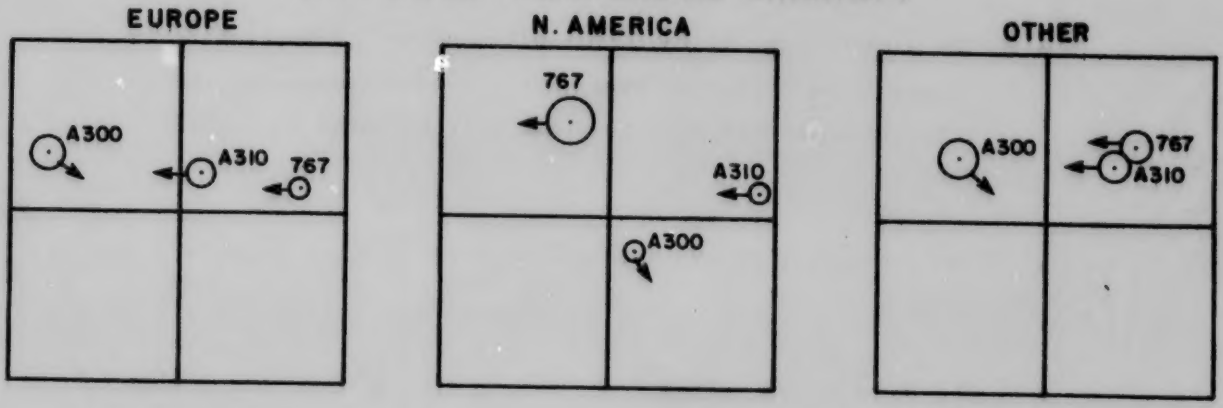
(BY MARKET SEGMENT AND WORLD REGION)

SINGLE-AISLE AIRCRAFT

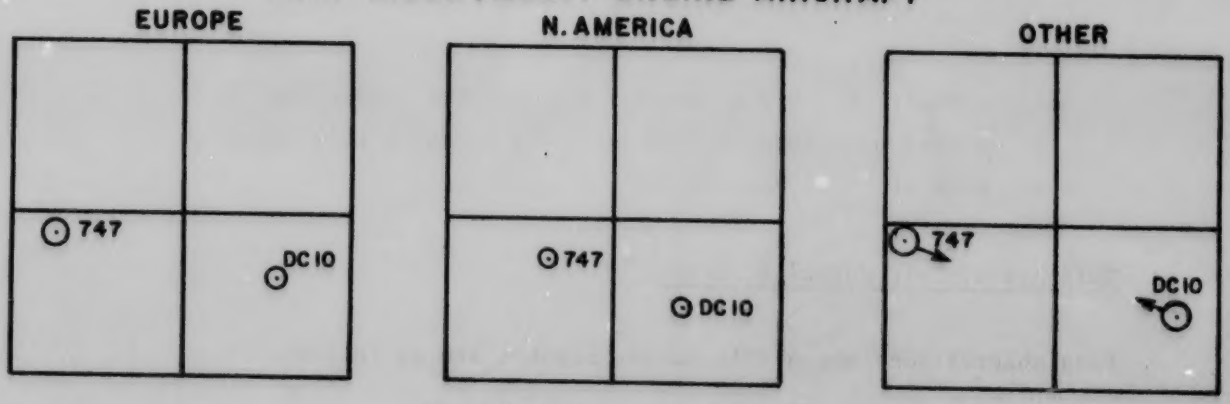


TWIN-AISLE, TWIN ENGINE AIRCRAFT

PRODUCT GROWTH



TWIN-AISLE, MULTI-ENGINE AIRCRAFT



MARKET SHARE

150 seater would be offset by reduced cash inflows from the 737-300 and the 757 program. Boeing would have to justify the viability of a new 150 seater in this light;

- Boeing has a dominant market share worldwide in the segments served by the 737-200 and 757 aircraft as seen in Exhibit 28. These aircraft have little competition in the market segments served by these aircraft;

- The Boeing 737-300 has been ordered in North America only;

- The market share of the McDonnell-Douglas DC9-Super 80 Series is very high in every World region because of the attractive economics of this aircraft compared to the 727-200;

- The derivative DC9-83 has been ordered in North America only.

- The DC9-30/40/50 aircraft have been displaced by the Boeing 737-200 in all world markets. McDonnell-Douglas would like to replace these aircraft with a new derivative, the DC9-Super 90;

- For Airbus, this segment represents the largest unfilled market opportunity. Airbus wants to enter this segment with its A320 aircraft.

Twin-Aisle, Twin Engine Aircraft

Some observations about this market segment are as follows:

- Airbus has its greatest strength in the non-North American markets. Both the A300 and the A310 have a greater share than the comparable Boeing 767 aircraft in this market, as seen in Exhibit 28;

- The Airbus presence in North America is very weak, with only one A300 customer;

- The Boeing 767 is facing strong competition from the Airbus A310. Only in North America does the B767 have a larger market share than the A310. Moreover, since the B767 is a new aircraft, it has yet to generate positive cash flows;

- McDonnell-Douglas has no aircraft in this market segment and is in a weak position to enter it.

Twin-Aisle, Multi-Engine Aircraft

Some observations about this market segment are as follows:

- The market share of the DC10 is low in every World region, however, sales of the DC10 have been low because of surplus widebody aircraft capacity in world fleets;

- Boeing has a dominant position in this market segment in every world region. Sales growth of the 747 has been slower than the growth of the other market segments because of an over-supply of aircraft of this capacity/range;

- Airbus does not have an aircraft in this market segment. This aircraft segment is not as attractive to Airbus as the single-aisle segment since the single-aisle market segment offers better immediate market prospects.

3.5 CORPORATE STRENGTHS AND WEAKNESSES

3.5.1 Airbus

The strengths of Airbus are many and include:

- the absence of existing commercial aircraft programs to protect; Airbus can design the best 150 seat aircraft without fear of hurting sales of existing products;
- the non-American image of Airbus which assists sales to certain countries that prefer to purchase non-American products;
- access to low-cost government loans to fund aircraft development programs;
- ability to help airlines in obtaining subsidized financing of aircraft because of European government backing;
- strong military programs in member companies which provide advanced technological know-how and cash flows to fund Airbus development programs;
- strong government commitment to existing programs, with commercial risks of the programs guaranteed by several government partners;
- a customer base in countries with high future growth potential, especially in Asia.

Some corporate weaknesses of Airbus include:

- major business decisions require political approval by several consortium members, making the approval both uncertain and slow;
- diverse national objectives of the consortium partners which can make it difficult to react to competitive pressures;
- a relatively narrow product line;
- labour productivity which is not as high as that of Boeing and McDonnell-Douglas, primarily due to the British Aerospace Corporation;
- an inability to alter production levels quickly to meet cyclical demand, due to national requirements to provide long-term steady employment; in the short term, Airbus may therefore not be able to capture all of its potential market share.

3.5.2 Boeing

The corporate strengths of Boeing include:

- a large customer base;
- a longstanding reputation with customers and a corresponding customer loyalty;

- a dominant market position in the world passenger aircraft market;

- a wide product range covering all market segments;

- a high commitment to the civil aviation market;

- lower production costs than competing airframe manufacturers;

- a flexible work force with the ability to expand or reduce employment levels to meet the cyclical demands of the airframe market;

- a growing defence business providing cash flows offsetting some of the effects of the downturn in aircraft orders and enabling the company to meet the cash requirements of new airframe developments;

- a design team which can produce a new aircraft faster than any other airframe manufacturer.

Boeing's weaknesses include:

- a negative image of the U.S. in some countries;

- a requirement to finance sales of aircraft to airlines, especially U.S. airlines, with limited government financing assistance;

- while launch customers are often American airlines, the resulting products may not be the most appropriate for all parts of the world;

- Boeing would be strained financially to develop a new aircraft because of cash flow constraints for the next few years.

3.5.3 McDonnell-Douglas

The corporate strengths of McDonnell-Douglas include:

- a large customer base:

- strong cash flows from military aircraft and missile programs;

- a flexible work force with the ability to expand or reduce employment levels to meet cyclical demand.

The corporate weaknesses include:

- an inability to make profits in the commercial aviation field;

- a negative image of the U.S. in some countries;

- the DC9 product line, being based on a 1960s design, is vulnerable to technological obsolescence;

- the large financing requirements to finance lease deals with several major airlines which may cause McDonnell-Douglas to have insufficient resources to launch a new 150 passenger aircraft;

3.6 ANALYSIS OF THE CURRENT STRATEGIC GAP, ANALYSIS OF STRATEGIC OPTIONS AND DEVELOPMENT OF ANTICIPATED STRATEGIES

3.6.1 Analysis of the Current Strategic Gap

Given the existing and announced aircraft programs of the airframe manufacturers, the predicted worldwide shares of aircraft sales for 1982-1986 for Airbus, Boeing and McDonnell-Douglas are given in Exhibit 29, opposite. Boeing is expected to capture a dominant 62% share of the worldwide market. Airbus is expected to have a 23% share, while the McDonnell-Douglas share is expected to decline to 12%.

Airbus

The current product portfolio will not achieve the corporate objective of a 30% world share. Even the present Airbus performance may be endangered since Boeing has stated its intention to capture 55% of the market served by the A310/A300. To achieve a 30% market share, Airbus must expand into other market segments, since a strategy which uses the present products alone will fall short of the corporate objectives.

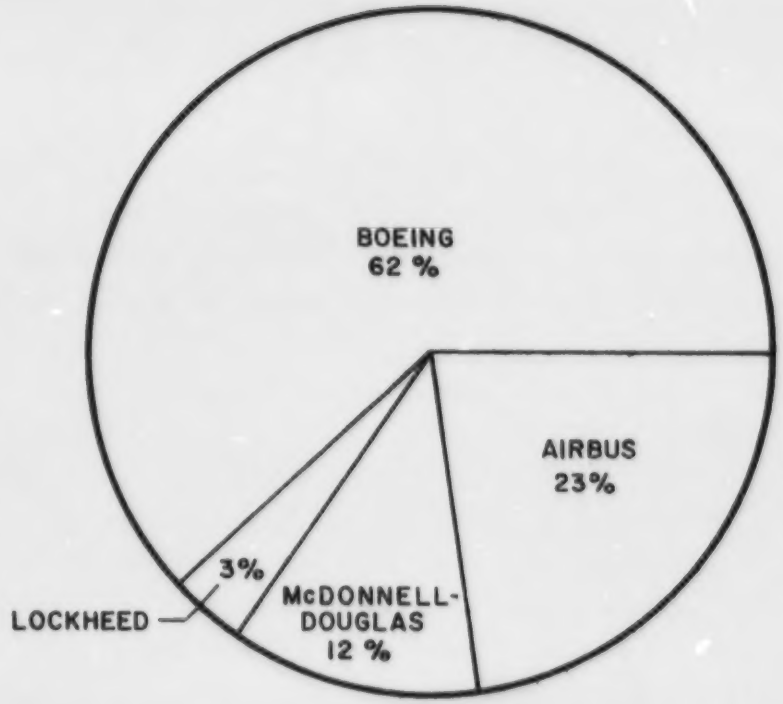
Boeing

Boeing does not currently have a strategic gap. Reference to the Boeing corporate objectives (domination of the world civil aircraft market and a reduction of its debt/equity ratio) shows that these are achieved or achievable with the company's present or known future product portfolio.

EXHIBIT 29

WORLDWIDE SHARES OF AIRCRAFT SALES*

1982 – 1986



* AIRCRAFT SEATING MORE THAN 100 PASSENGERS

SOURCE: CYRUS J. LAWRENCE; August 13, 1982

As part of its move to maintain its dominant position, Boeing is developing a stretched 767 to compete with the A300. Furthermore, Boeing believes it can capture 55% of the sales in the segments served by the A300 and A310 aircraft. Lastly, Boeing believes that its 737-300 derivative and 757 aircraft will adequately serve the requirements of airlines wanting aircraft in the 140-170 passenger capacity segment (the Boeing "gap").

The launch of a 150-passenger new technology aircraft (the anticipated A320) would result in a product gap. This gap will threaten the achievement of Boeing's corporate objectives and pose a strategic threat.

McDonnell-Douglas

The current McDonnell-Douglas product line will allow McDonnell-Douglas to stay in the commercial aircraft market. Since the market potential for single-aisle aircraft appears very large, McDonnell-Douglas' strategy is to develop derivatives to compete in the single-aisle aircraft passenger market, given the limited financial resources of the company.

The company is attempting to establish the DC9-80 aircraft in as many airline fleets as it can. Once the DC9-80 aircraft is in airline fleets, airlines will have strong reasons to continue with the DC9-80, as discussed in Section 2, rather than purchase another 150-passenger aircraft to meet their 150-seater requirements, especially if the new 150-seat aircraft is not significantly better in economic terms.

The launch of a new technology 150-passenger aircraft by a competitor would, however, create a strategic gap. McDonnell-Douglas would not likely have the financial resources to launch a new technology 150-passenger aircraft of its own. Furthermore, the DC9-80 may not be able to compete profitably against the new aircraft.

3.6.2 Strategic Postures of Airbus, Boeing and McDonnell-Douglas

The Strategic Position and Action Evaluation (SPACE) methodology was used to assist in determining which strategic position best fits a company's ability to respond to market demands and industry conditions. The SPACE methodology is an extension of several two-dimensional portfolio methods such as industry attractiveness/company strength matrix and BCG product portfolio. This approach examines four factors: industry strength, environmental stability, competitive advantage, and financial strength. These factors serve as the basis for evaluating each aerospace company's strategic position and indicated strategic action.

The assessment of the four factors is based on multiple factors (see Appendix D). The competitive advantage and financial strength factors incorporate our assessment of corporate strengths and weaknesses, as discussed in Section 3.5. The industry strength and environmental stability factors which are common to each company are assessed, as discussed in Section 2.

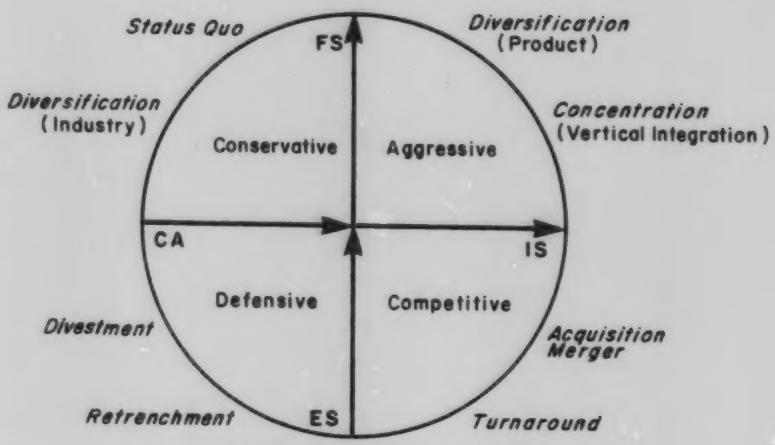
The result of the SPACE analysis is shown in Exhibit 30, overleaf. This exhibit shows the most appropriate strategic position for each aerospace firm and assists in revealing the "true" corporate objectives.

The posture of both Airbus and Boeing is "aggressive", with Airbus more inclined towards a competitive posture and Boeing more towards financial conservatism. Both, however, show a posture of concentration in their existing (competing) product/market area.

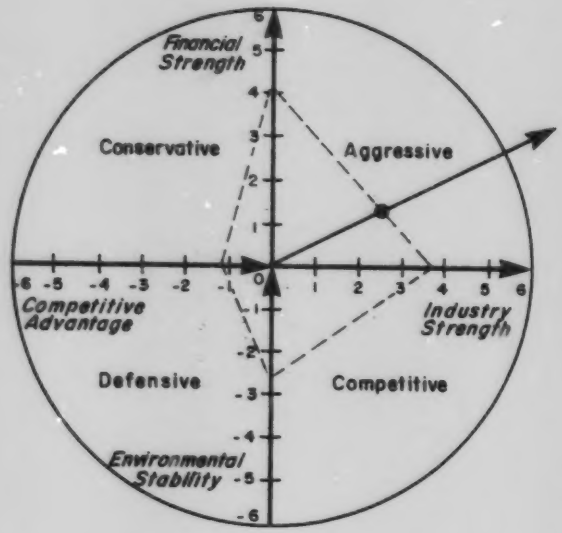
In contrast, the McDonnell-Douglas posture is defensive to the point of retrenchment, but not (yet) divestment. A further decline in competitive position would produce a "divestment" posture.

EXHIBIT 30

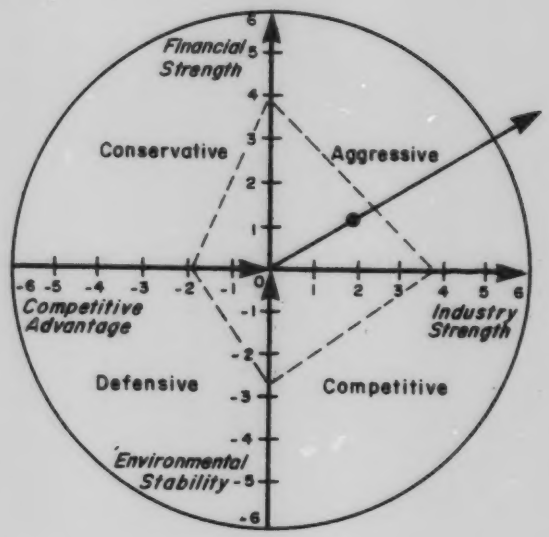
STRATEGIC POSTURES OF LEADING AIRFRAME MANUFACTURERS



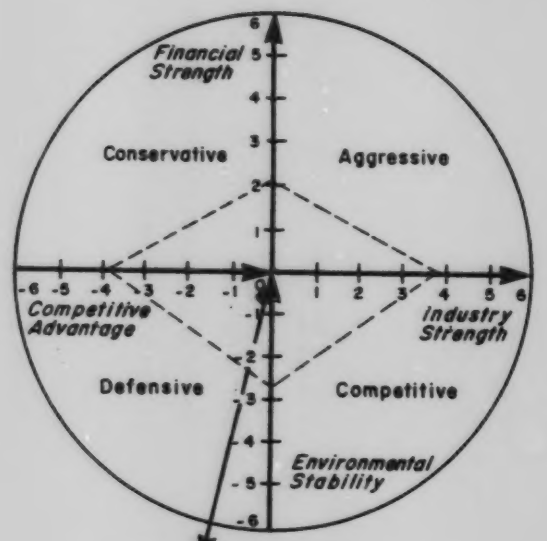
STRATEGIC ALTERNATIVES



AIRBUS



BOEING



McDONNELL-DOUGLAS

3.6.3 Evaluation of Feasible Strategic Options and Deduction of the Anticipated Strategies

Airbus

To come closer to achieving a 30% world share, Airbus must consider some strategic alternatives. Some alternatives are:

- Introduce a stretched version of the A300 to produce the TA9 for competition in the 270-350 passenger market segment which has a forecast demand of over 600 aircraft in the period 1982-2002;

- Introduce a 150-passenger aircraft (A320) to compete in the 140-170 seat segment - a segment served only by the DC9-Super 80 series. Our studies show that the A320 should be competitive with the DC9-Super 80 (see Appendix B). Derivative versions of the A320 could be introduced later to compete with the 737-300 and the 757. Airbus forecasts that the total demand for passenger aircraft in these segments should exceed 3,500 aircraft in the period 1982-2002.

The 150-seat market segment is the most attractive for Airbus to pursue as it provides the best prospects for Airbus to meet its corporate objectives.

In the 140-170 seat segment, Airbus could expect to capture 26% of the world market (see Section 4 for a derivation of the Airbus market share). The introduction of the A320 to the Airbus product line will allow Airbus to meet its corporate objective of obtaining a 30% share of the world market. Furthermore, the market share obtained by the A320 should be large enough for

the A320 to be a commercial success. A full discussion of the anticipated market shares for the 150 seat aircraft is presented in Section 4 of this report.

Table 1, following, summarizes the anticipated Airbus Strategy.

Boeing

If a new technology 150-seater aircraft (A320) is introduced, Boeing is faced with a strategic threat. The options open to Boeing in responding to this strategic threat are either to offer the 737-300 and the 757 as alternatives to the A320 or to develop an all new 7-7 aircraft to compete directly with the A320.

Boeing is clearly in a strong position and it will not alter its product line unless forced to do so by competitor action. Such action would be the introduction of an A320 from Airbus. Boeing considers the 150-passenger market segment as too important to lose since the 100-200 passenger category represents more than half the market, and "gaps" in that category may not be viewed by Boeing as affordable in the long term.

Because Boeing would be financially stretched to launch a new 150-seat aircraft in 1983 or 1984, it may prefer to delay the launch of a 7-7 for as long as possible. There is a possibility that Boeing may still decline to develop a new 150-seater in response to an Airbus entry. Such a strategy would represent a "wait and see" approach, which would provide Boeing with short-term financial advantages, while keeping its options open. Such a delay, of say two years, may enable Boeing to better assess the degree of technological advance and overall competitiveness of the A320, and provide Boeing with an opportunity to enter the new technology 150-passenger segment later, but with a more advanced product. This strategy would also delay the erosion of sales for Boeing's existing products (the 737-200 and 757) in the short term (1983-90).

There is also the possibility that Boeing may enter into a joint venture with Japanese interests to build a 150-seat airplane. This possibility is strengthened by the current Japanese participation in the 767 (10%). This possibility would reduce the financial burden of a new 150-seat program and increase the likelihood of an early response to an announced A320.

In our assessment, Boeing will adopt a "wait and see" approach until its financial position improves sufficiently for it to develop the 7-7 in partnership with the Japanese. The introduction into service of the 7-7 would likely be in 1990 if Airbus commits to the A320 in 1983.

Table 2, following, summarizes the anticipated Boeing strategy.

McDonnell-Douglas

McDonnell-Douglas is faced with a weak product portfolio. It is presently dependent on the success of the DC9-80 aircraft to remain in the commercial aircraft business. The launch of a new technology aircraft for entry into service in 1988 would likely force the DC9-Super 80 out of the market by the early 1990's.

McDonnell-Douglas may be able to broaden its sales base by developing a new derivative (DC9-Super 90) to compete successfully in the 85-140 passenger segment to offset competitive threats posed by a new 150-passenger aircraft to its product portfolio. Lack of resources also make it difficult to make needed improvements to the DC-10 aircraft.

McDonnell-Douglas may find it increasingly difficult to remain in the commercial aircraft market and will likely exit from the market in the early 1990's if the market size for the DC9-Super 80 and Super 90 series aircraft is small.

Table 3, following, summarizes the anticipated McDonnell-Douglas strategy.

TABLE 1

SUMMARY: AIRBUS INDUSTRIE ANTICIPATED STRATEGY

CORPORATE OBJECTIVES	1. Achieve a 30% share of the world passenger jet market. 2. Become a full-line competitor. 3. Establish Airbus as the number 2 world producer of civil jet aircraft.
CURRENT PERFORMANCE	The current product line will yield only a 23% world market share.
GAP	7% market share.
STRATEGIC ALTERNATIVES	1. Develop a new technology single-aisle aircraft. 2. Develop the TA9 to compete in the 270-350 passenger market segment. 3. Develop a long-range 200 passenger aircraft.
STRENGTHS	Strong financial backing from European governments. The non-American image of Airbus favours sales to airlines in many parts of the world.
WEAKNESSES	The decision-making process is slow because consortium (government) approval is required for major business decisions. The requirement for level production (no layoffs policy) may result in an inability to adjust production levels to meet cyclical demand.
STRATEGIC OPPORTUNITY	The largest potential market is in the 150 seater segment. The Airbus corporate objective can be achieved with the A320 in the product line.
THREATS	Boeing may erode sales of the current product line (A310/A300) with its 767 aircraft and thus reduce the projected Airbus market share.
ANTICIPATED STRATEGY	Airbus will launch the A320 aircraft to compete in the single-aisle market. After introduction in 1988-89, Airbus will pursue the development of derivatives and/or new aircraft types to compete with the Boeing family of aircraft.

TABLE 2

SUMMARY: McDONNELL-DOUGLAS
ANTICIPATED STRATEGY - 150 SEATER INTRODUCED

CORPORATE OBJECTIVE	Maintain a presence in the commercial aircraft market for as long as possible to exploit a large single-aisle market potential.
CURRENT PERFORMANCE	Current product line may not achieve desired corporate objectives.
GAP	The DC9 aircraft may not be able to compete profitably in the single-aisle aircraft market.
STRATEGIC ALTERNATIVES	1. Develop or improve derivatives to compete in the single-aisle market. 2. Exit from the market.
STRENGTHS	The DC9-80, a single-aisle aircraft, is presently in the company product line and is in airline fleets in substantial numbers. Derivatives of current aircraft can be developed to compete in other segments of the narrow body market.
WEAKNESSES	Financial cash flow constraints do not permit McDonnell-Douglas to build a new technology narrow-body aircraft.
STRATEGIC OPPORTUNITY	The single-aisle aircraft market is the largest market segment in the period 1982-2002
THREATS	A new technology single-aisle aircraft may be so advanced as to make the DC9-80 economically unattractive for airlines.
ANTICIPATED STRATEGY	McDonnell-Douglas will pursue sales of the DC9 aircraft for as long as possible. Furthermore, McDonnell-Douglas will compete only in areas where the DC9-80 has economic advantages to offer airlines. If the market size for the DC9-80 is too small, McDonnell-Douglas will exit from the market.

TABLE 3

SUMMARY: BOEING
ANTICIPATED STRATEGY - 150 SEATER INTRODUCED

CORPORATE OBJECTIVES	1. Maintain a greater than 50% share of the world market. 2. Reduce the debt/equity ratio to the historical (low) level. 3. Provide full product coverage in all segments of the market.
GAP	Potential strategic gap posed by entry of a new 150 passenger new technology aircraft.
CURRENT PERFORMANCE	The 737-300 and 757 sales will be threatened by the A320 and the overall Boeing market share might fall to 50%.
STRATEGIC ALTERNATIVES	1. Attempt to compete against the A320 with the current 737-300 and 757 aircraft. 2. Develop a new technology single-aisle aircraft to compete with the A320. 3. Develop a derivative (737-400) to compete directly against the A320.
STRENGTHS	The Boeing design team can produce a new aircraft faster than any other airframe manufacturer. Boeing has lower production costs than competitor airframe manufacturers. The Japanese have expressed interest in becoming 30% equity partners in a single-aisle aircraft.
WEAKNESSES	Cash constraints arising from a downturn in aircraft sales and because of massive new aircraft development programs. Boeing wants to protect the sales prospects of its 757 and 737-300 products. Boeing's traditional launch customers are large American airlines. These airlines are, in general, not profitable now.
STRATEGIC OPPORTUNITY	Largest market in the period 1982-2002 is in the single-aisle segments.
THREATS	Boeing may lose its dominance of the narrow body market if the A320 is able to displace the present 737 and 757 series aircraft.
ANTICIPATED STRATEGY	Boeing will wait as long as possible to incorporate the latest technology into a new single-aisle aircraft. It will then launch a 7-7, in partnership with the Japanese, to compete with the A320. The introduction of the 7-7 could be as much as two years after the entry into service of the A320.

3.7 FUTURE PRODUCT PORTFOLIOS

3.7.1 Future Product Portfolio for Each Aerospace Company

The future product portfolios respresent the outcome of the anticipated strategies deduced in Section 3.6 and the strengths and weaknesses of each airframe company. The future product portfolios in 1992 for each company are illustrated in Exhibit 31, overleaf.

Airbus Industrie

- The product portfolio should be in balance, providing positive cash flows that could be used to add another aircraft to the Airbus "family";

- The product line of Airbus will still be quite narrow with the A320 competing with the Boeing 7-7 and the A300/A310 competing with the Boeing 767. A derivative of the A320 may be contemplated to compete with the Boeing 757 to fill an Airbus product gap;

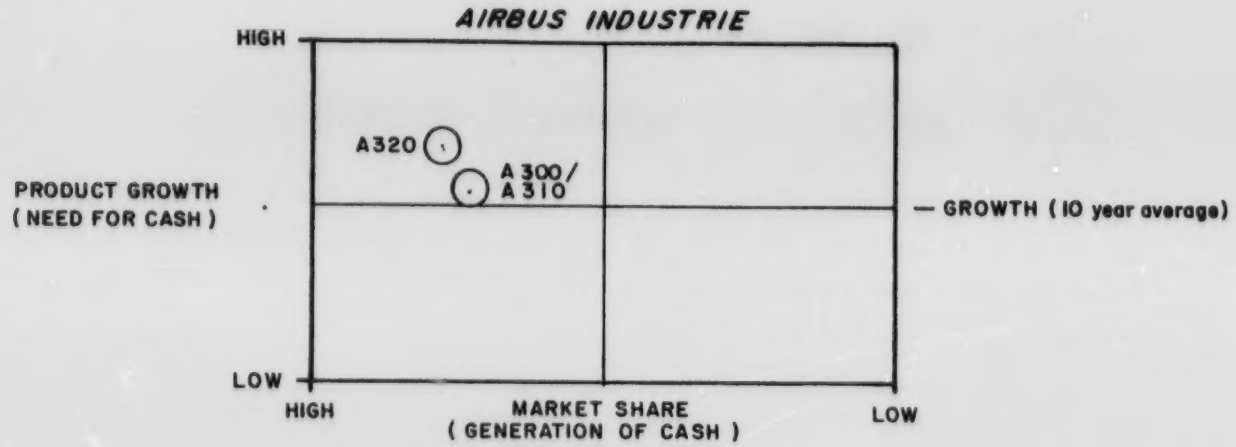
Boeing

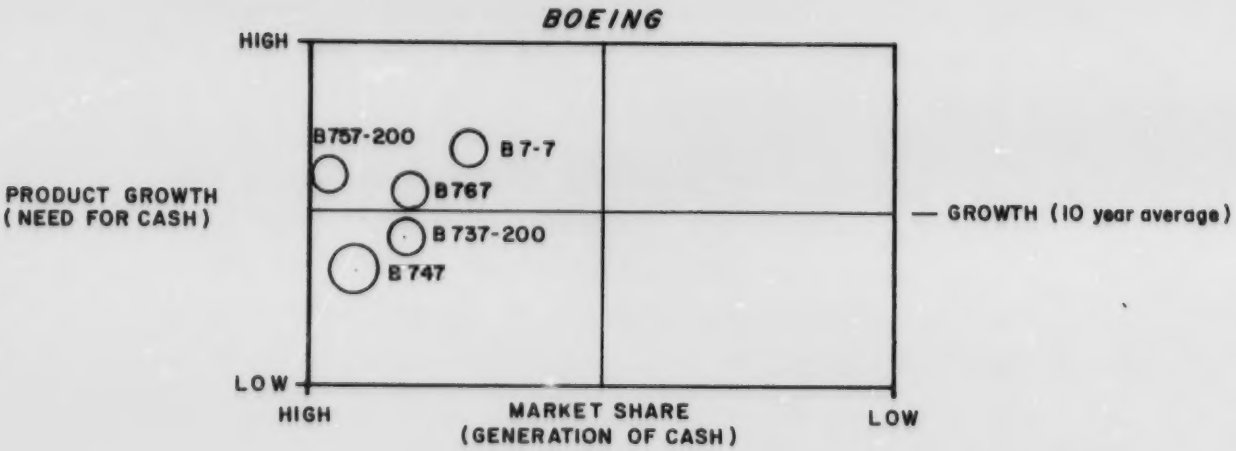
- The product portfolio should be generating very strong positive cash flows for Boeing in 1992, as seen in Exhibit 31. Furthermore, Boeing will continue to have the widest product line of any airframe manufacturer;

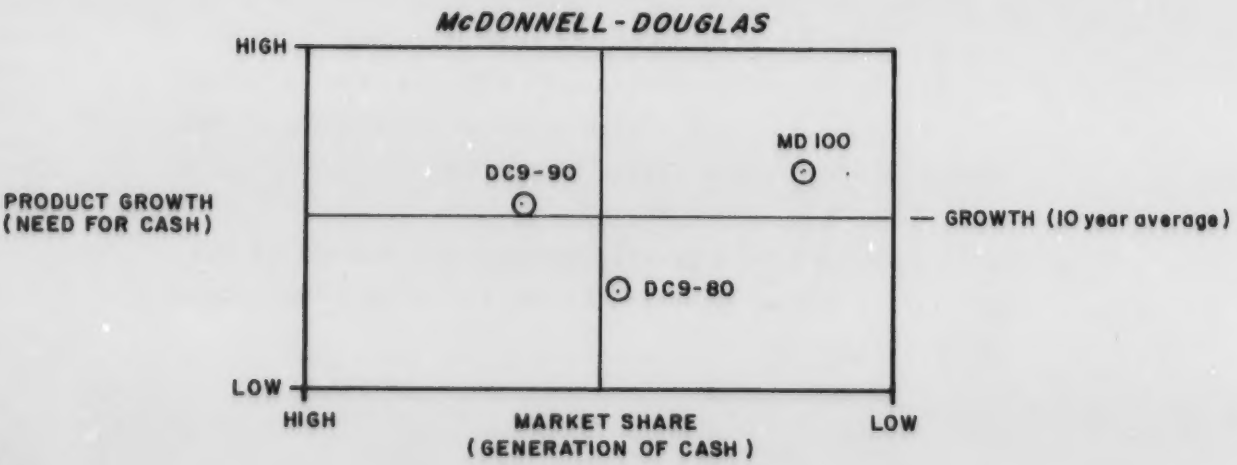
- Boeing should have a greater market share for all of its aircraft with the exception of the 7-7, than other manufacturers will enjoy;

EXHIBIT 31

FUTURE (1992) PRODUCT PORTFOLIOS







- The 737-200 will be an aging design and Boeing may develop a replacement aircraft. A replacement aircraft may incorporate advanced turbo-props;

- The 737-300 will have been discontinued, having been replaced by the 7-7.

McDonnell-Douglas

- The product portfolio may be generating small positive cash flows if a DC9-Super 90 (a DC9-30/40/50 replacement) is developed. If the MD-100 derivative is introduced, the product protfolio will have a negative cash flow;

- The market position of McDonnell-Douglas will be quite weak, with a fairly unattractive product line. The DC9-Super 80 series will be exiting from the market. McDonnell-Douglas will not have another aircraft to offer to this segment of the market to compete with the Boeing 7-7 and the Airbus A320 because of insufficient development funds in the mid-1980's to develop a new 150-seater aircraft.

3.7.2 Future Product Portfolio for Each Aircraft Capacity/Range Segment by World Market

The anticipated product portfolios for each aircraft capacity/range segment by World market resulting from the anticipated strategies developed in Section 3.6 are illustrated in Exhibit 32, opposite. The following are some observations about the anticipated future product portfolios:

- Airbus should have a larger market share than Boeing for the A300, A310 and A320 aircraft types in all parts of the world except North America;

- Boeing will have strong share in North America and in other parts of the world except Europe. Boeing will enjoy a dominant market share for its 757, 747 and 737-200 products. Boeing will have a lower than Airbus market share for the 7-7 and 767 in non-North American markets which will compete with the A320 and A300/A310, respectively. However, sales growth for the 7-7 should be higher than for the A320 such that the 7-7 should have a higher market share than the A320 in all world markets by the mid-1990's;

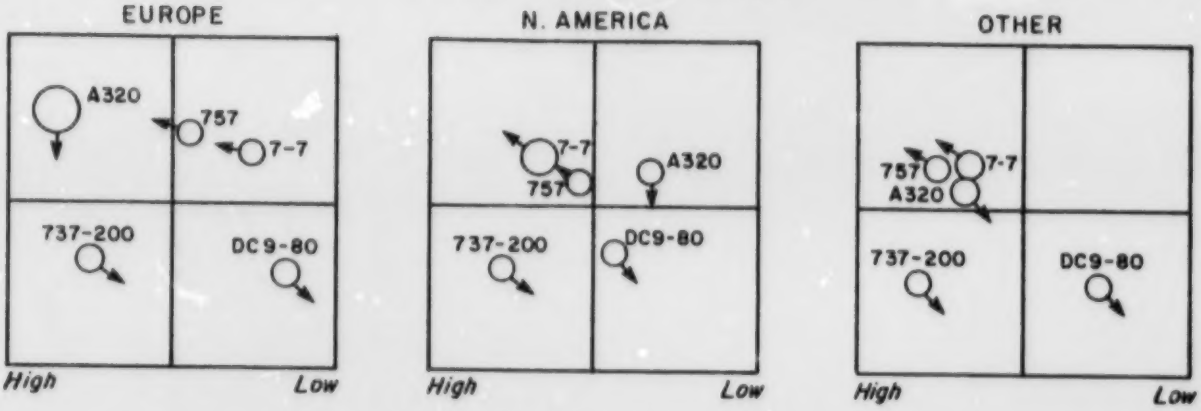
- The DC9-Super 90 will be in a good position in all world regions in 1992, as seen in Exhibit 32. Its position will, however, be vulnerable if a new technology aircraft is launched to replace existing aircraft in the 85-140 seat segment. McDonnell-Douglas may not be able to remain in the commercial aircraft business since the 85-140 seat segment may be declining in size in 1992.

EXHIBIT 32

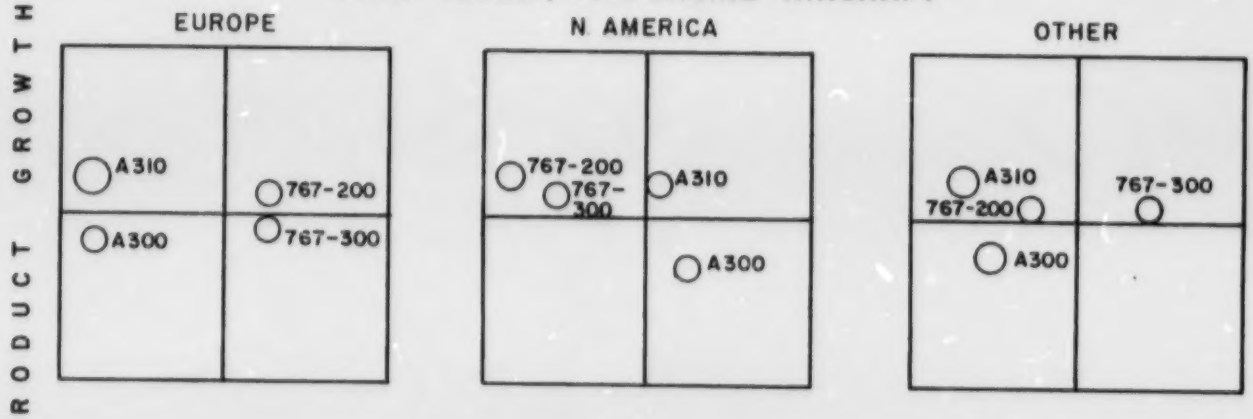
FUTURE (1992) PRODUCT PORTFOLIOS

(BY MARKET SEGMENT AND WORLD REGION)

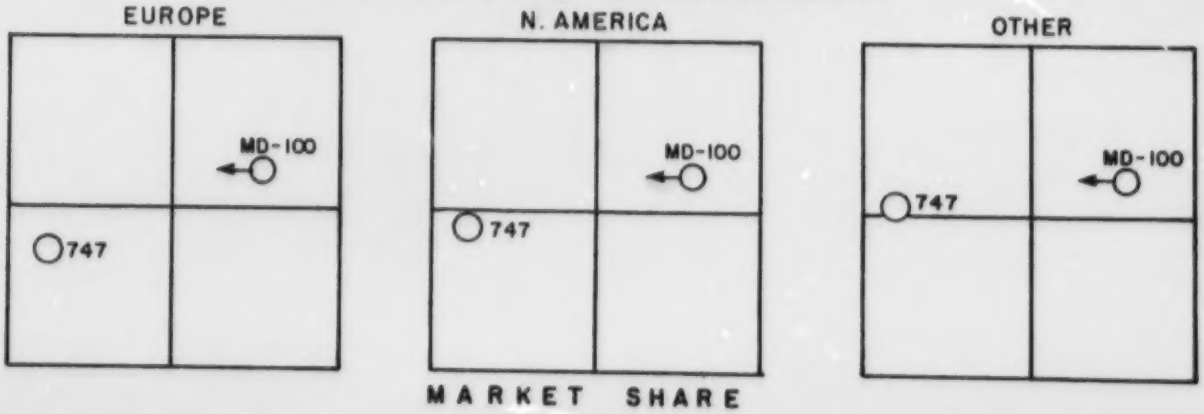
SINGLE-AISLE AIRCRAFT



TWIN-AISLE, TWIN ENGINE AIRCRAFT



TWIN-AISLE, MULTI ENGINE AIRCRAFT



4. MARKET SHARES FOR SINGLE-AISLE AIRCRAFT INCLUDING THE A320

The analysis in Section 3, Aerospace Strategic Analysis, cannot be used alone to determine precisely what the market shares of each aerospace manufacturer will be in the period 1988-1992. The analysis does, however, suggest that Airbus will likely launch the A320 for delivery in 1988 and that Boeing will respond to the A320 with the 7-7 aircraft, but with an entry into service two years later than the A320. Furthermore, the analysis suggests that McDonnell-Douglas will not develop a new aircraft to compete with the A320 and that the DC9-80 will be forced to exit from the market. By the mid-1990's, only Airbus and Boeing will compete in the 150-passenger market.

The implications of the strategic analysis in Section 3 are further elaborated on pages 73 and 74, following.

According to sources at Boeing, the breakeven point for a new aircraft program is expected to occur when a sales level of 700 aircraft is reached. However, the breakeven sales level for Airbus, given the same selling price as for Boeing, will tend to be lower, despite Airbus' lower productivity, since Boeing will have to pay a higher "real" interest rate for its development of the 7-7 than will Airbus, as Boeing has to pay U.S. market rates. The precise breakeven level is very sensitive to development costs, production costs, final selling price and financing costs. Both Boeing and Airbus are confident that the market for new 150-seat aircraft is large enough for each to reach a breakeven sales level.

To determine the market shares for the major aerospace companies, a top-down approach is used. In this approach, a segmentation of the single-aisle aircraft market is performed to establish the sizes of each of the three single-aisle aircraft classes. Then, within the 150-seat aircraft class, the market shares for each aerospace competitor are established for each world geographic region and by time period.

4.1 SEGMENTATION OF THE SINGLE-AISLE AIRCRAFT MARKET

Smaller aircraft such as the Boeing 737-200 or larger aircraft such as the Boeing 757 can sometimes be substituted for a 150 seater aircraft. Because of the potential use of various single-aisle aircraft types to meet an airlines' need for 150 seater aircraft, the market shares for all the single-aisle classes (e.g., "110", "150" and "200" as defined in Appendix C) must thus all be determined.

Determining the market shares for single-aisle aircraft in the period 1988 to 2002 requires, as a basis, a forecast of future air traffic. The steps involved in forecasting requirements for new single-aisle passenger aircraft are:

a) Forecasting the demand for air travel for different areas of the world.

b) Forecasting the shares that each aircraft class will take of the future airline fleets to meet the projected air traffic in (a).

c) Forecasting the numbers of aircraft required in each class considering the numbers of aircraft presently in these classes, the projected seating capacity of aircraft in each class and the replacement of aircraft scheduled for retirement.

The methodology is outlined in greater detail in Appendix A.

4.1.1 Forecast of Demand for Air Traffic

Air traffic growth is the most important factor determining future requirements for new aircraft. Current econometric models are inadequate to forecast international air traffic; past trends in air traffic growth must therefore be

identified and modified by judgement to produce a forecast of future air traffic growth. Our forecast is not to be considered a definitive forecast of aircraft deliveries.

In this study, the predicted growth rates are based on a review of work by such organizations as the FAA and ICAO and industry work by General Electric, Pratt & Whitney, Boeing, McDonnell-Douglas and Airbus. Furthermore, the load factors experienced by airlines are assumed to remain constant; hence, the growth rates in air traffic will be the same as the growth in Available Seat Kilometres. The forecasts of available seat kilometres using the anticipated growth rates are shown in Exhibit 33, overleaf.

4.1.2 Forecast of Future Fleet Mix

In this study, we only forecast the fleet mix of narrow-body jet aircraft with seating capacity of 85 passengers or more. The fleet mix is projected for the "110", "150" and "200" classes. These classes, which are defined in Appendix C, correspond to typical average seating capacity in each class.

The fleet in each class at the end of 1981 was taken as the basis for projecting the future fleet mix. The Boeing 737-300 was assigned to the "110" class, the A320 and the Boeing 7-7 aircraft were assigned to the "150" class, while the 757 was assigned to the "200" class.

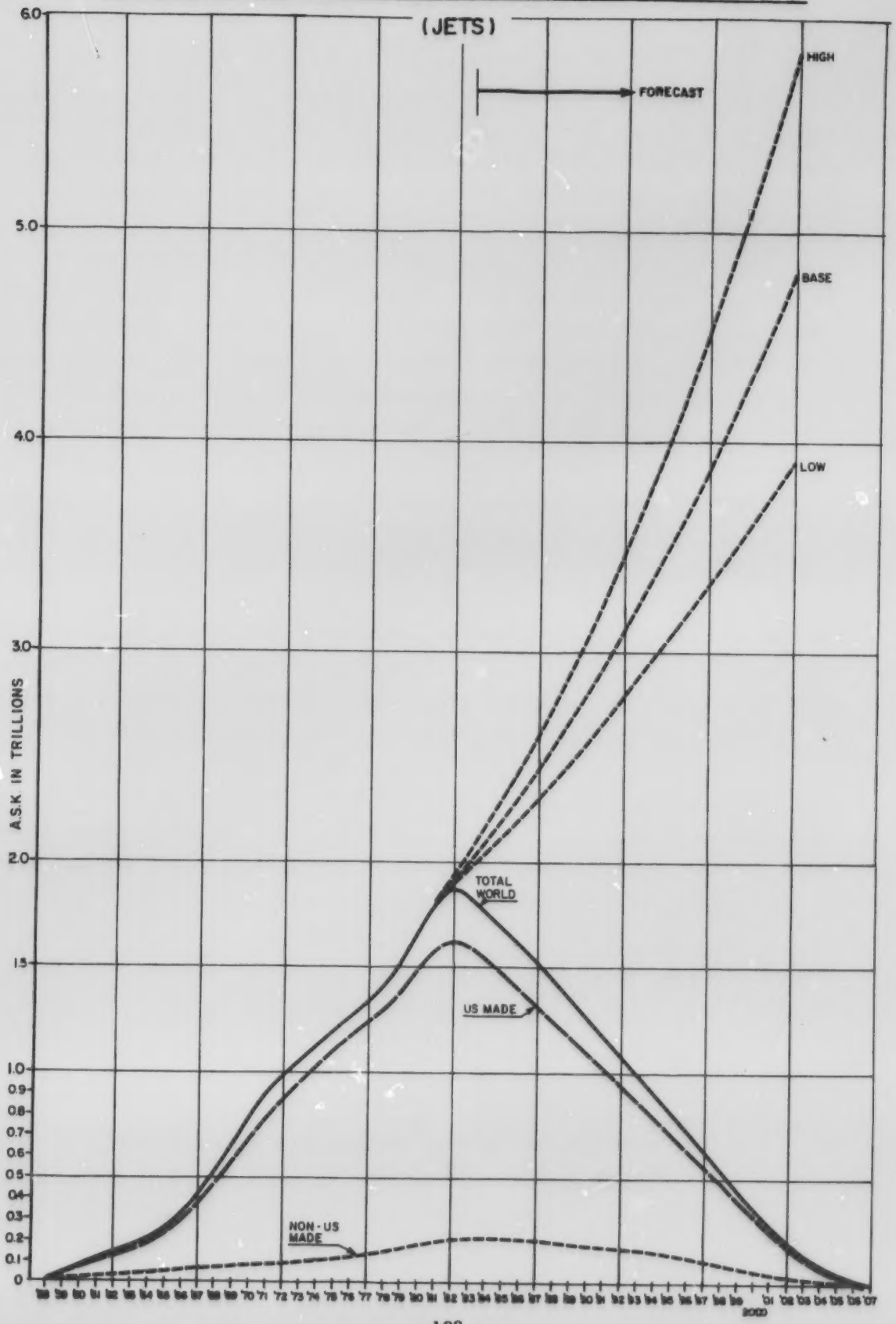
The relative shares of each of the three classes were estimated in three steps:

a) Projected growth in ASK's was divided into:

- growth in the average seating capacity of fleets within a class, and

EXHIBIT 33

HISTORICAL AND PROJECTED AVAILABLE SEAT KILOMETRES



- growth in fleet size (numbers of aircrafts) within each class.

b) Typical aircraft size was projected for each of the three classes for the years 1987, 1992, 1997 and 2002.

c) The shares enjoyed by each of the three single-aisle classes were arrived at through a process of iteration. The process met the constraint that the projected overall average seating capacity equal the weighted average seating capacity of the three classes.

See Exhibit 34, overleaf, for the single-aisle aircraft shares.

A more technical discussion as to how the projected growth rates, average seating capacities and the share enjoyed by each of the "110", "150" and "200" classes were obtained is given in Appendix A.

4.1.3 Forecast Requirements for New Single-Aisle Aircraft

Using the results of sections 4.1.1 and 4.1.2 and the base forecast for air traffic growth rates, the expected future aircraft fleets can be determined. The requirements for new single-aisle aircraft, at any given time, are equal to the total future fleet required less the remaining unretired fleet at that time. The requirements for new aircraft correspond to the gap between the required ASK's to meet future traffic requirements and the ASK's generated by the non-retired fleet to meet these requirements.

The forecast of the required fleet to meet future traffic requirements, a forecast of the remaining fleet and the resulting requirement for new single-aisle aircraft was made for the years 1987, 1992, 1997 and 2002.

EXHIBIT 34

PERCENTAGE SHARES OF AIRCRAFT CLASSES

GENERIC CLASS

	"110"	"150"	"200"	Total
North America				
1981	28%	45%	3%	76%
1987	38	35	3	76
1992	44	28	4	76
1997	42	27	7	76
2002	39	27	10	76
Europe				
1981	50%	18%	3%	71%
1987	47	20	4	71
1992	41	24	6	71
1997	31	30	10	71
2002	24	33	14	71
Other				
1981	37%	23%	4%	64%
1987	32	25	7	64
1992	26	29	9	64
1997	19	30	15	64
2002	14	30	20	64

The projected requirements for new single-aisle aircraft for the periods 1988-1992, 1993-1997, 1998-2002 and 1988-2002 by world geographic area are shown in Exhibit 35, following. Exhibit 35 clearly indicates a large potential market for the "150" seat generic class - the market in which the A320 will initially compete.

The requirements for new 150-seater aircraft are sensitive to the growth of air traffic. Using the low, base and high forecasts, the requirements for aircraft in the "150" class are shown in Exhibit 36, following. In the high growth scenario, the requirement for new 150-seater aircraft would be 25% above the base forecast. In the low-growth scenario, demand for new 150-seater aircraft would be 23% lower than the base forecast for the 1988-2002 period.

4.2 MARKET SHARES OF NEW 150-SEATER AIRCRAFT

4.2.1 Factors Affecting Market Shares

The market shares that each airframe manufacturer can capture of the new 150-seat aircraft market depends on several factors. These factors include:

- the effects of political factors on the potential supply of jet aircraft;
- the economic attractiveness of new aircraft to airlines (measured by selling price and direct operating costs) relative to competing aircraft;
- the unwillingness of airlines to mix aircraft types of the same passenger capacity;

EXHIBIT 35

REQUIREMENTS FOR NEW SINGLE-AISLE AIRCRAFT BY AREA
(BASE FORECAST)

	1988-1992	1993-1997	1998-2002	Total
North America				
"110"	618	285	145	1048
"150"	220	353	407	980
"200"	90	155	173	418
Total	928	793	725	2446
Europe				
"110"	191	51	30	272
"150"	171	216	220	607
"200"	58	90	111	259
Total	420	357	361	1138
Other				
"110"	213	88	61	362
"150"	365	310	372	1047
"200"	139	297	383	819
Total	717	695	816	2228
World				
"110"	1022	424	236	1682
"150"	756	879	999	2634
"200"	287	542	667	1469
Total	2065	1845	1902	5812

EXHIBIT 36

REQUIREMENTS FOR NEW "150" SEAT AIRCRAFT
(LOW, BASE AND HIGH TRAFFIC GROWTH FORECAST)

	N. America	Europe	Other	Total
1988-1992				
Low Forecast	187	125	318	630
Base Forecast	220	171	365	756
High Forecast	273	198	411	882
1993-1997				
Low Forecast	305	143	232	680
Base Forecast	353	216	310	879
High Forecast	416	265	398	1079
1998-2002				
Low Forecast	322	127	269	718
Base Forecast	407	220	372	999
High Forecast	510	294	538	1342
1988-2002				
Low Forecast	814	395	819	2028
Base Forecast	980	607	1047	2634
High Forecast	1199	757	1347	3303

- the marketing and financing practices of the aerospace manufacturers affecting aircraft supply;

- the production constraints faced by Airbus because of a requirement to retain a level workforce.

Effect Political Factors on the Potential Supply of Aircraft

The political factors affecting aircraft purchase were developed through a survey of Purchase Influencing Factors (Boeing vs. Airbus) conducted through Canadian Embassies by the Department of Industry, Trade and Commerce. The survey indicated a strong bias, in many non-U.S. countries, favouring the purchase of Airbus aircraft if technical and financing factors were equal.

The market share ranges for Airbus and Boeing, as determined by the survey, are as follows:

Market Share Range

	Airbus Industrie	Boeing
Europe	53 - 86%	14 - 47%
N. America	0 - 19%	81 - 100%
Other	32 - 61%	39 - 68%
World	23 - 49%	51 - 77%

Our assessment of the market shares for the Boeing 7-7 and the A320 incorporates the impact political factors may have on aircraft sales.

Economic Attractiveness of New Aircraft to Airlines

While the 727 (a 150-seater) is being phased out of production, Boeing is offering the 737-300 and the 757 as alternatives. The most direct competition to the proposed A320 with 156 seats is presently the DC9-80 with 152 seats.

An economic comparison between the DC9-80, Boeing 737-300 and the A320 indicates, broadly speaking, that the A320 would be economically viable in the $27 million to $31 million price range (U.S dollars), depending on stage length, fuel price and on the airlines' cost of capital. Calculations of the estimated competitive position of the A320 are to be found in Appendix B. Sources in the British government have indicated a probable price of about $28 million (in current 1983 dollars) for the A320. At this price, the A320 can hope for a reasonable market share. It is unclear, however, if the Airbus program will be economically viable at this price level. The viability of the program will depend on the amount spent on research and development and the level of production efficiency.

If the price of the A320 aircraft could be reduced to below $26 million in 1983 U.S. dollars, the market share of the A320 might double in comparison with the minimum market shares indicated below. However, at this price, the A320 would be unlikely to recover its development costs, even with the higher market shares.

The decision to reduce the seating capacity (at a 32" pitch) of the A320 from 162 seats to 158 seats has adversely affected the economic attractiveness of the A320. Although a reduction from 162 to 158 seats (at 32" pitch) does not appear to be very large, a significant portion of the revenue reduction caused by the lower capacity comes directly off the "bottom line", being only partially offset by the savings obtained from a reduction in aircraft weight.

Unwillingness of Airlines to Mix Aircraft Types

As was discussed in Section 2.1, airlines do not want different aircraft from different manufacturers with the same passenger capacities because of the economic costs associated with mixed fleets. Thus airlines would react unfavourably to having both the DC9-80 series aircraft and A320 in their fleets. McDonnell-Douglas is introducing as many DC9-Super 80's into airline fleets as it can before the first A320's are delivered. With the DC9-Super 80 in airline fleets, the Airbus A320 will have a smaller potential client base because airlines will be reluctant to mix the DC9-Super 80 and the A320. This factor tends to reduce the potential market share of the A320 and has been incorporated into our assessment.

In addition to the reductions in economic advantage, a 158-seat aircraft would not be much different in the eyes of many airlines from the 152-seat DC9 Super 80 in terms of optimal seating capacity for particular route structures. Many carriers who may commit themselves between now and 1988 to the DC9 Super 80 may be reluctant to mix into their fleet a different aircraft of practically the same size, even if that aircraft showed cost savings. It is unfortunate that the reduction in seating capacity affected two competitive factors in the same (negative) direction: it narrowed the perceived size advantage of the A320 and, instead of compensating for this problem through better economic performance, the capacity reduction also narrowed the cost advantage of the aircraft.

The change in the seating capacity of the A320 has lowered our original estimates of the market share the A320 could capture. At 162 seats, we believed that the A320 could have captured the following market shares:

	MARKET SHARE RANGE
North America	10-20%
Europe	50-75%
Other	30-50%

At 158 seats, the present configuration of the A320, our estimate of the A320 market share is reduced, since the A320's economic advantage is extremely sensitive to seating capacity, and the perceived difference between the A320 and its nearest competitor, the DC9-80, is greatly reduced. Our revised market share range estimate is as follows:

	MARKET SHARE RANGE
North America	5-15%
Europe	40-65%
Other	25-45%

These market shares reflect our assessment of political factors on potential demand and the unwillingness of airlines to mix aircraft types.

Several factors might affect the conclusions above. For example:

- If fuel prices were to rise dramatically again, the market share of the A320 could rise significantly, even at a price of $28 million. However, growth in air traffic would decline and the total demand for new aircraft would be lower.

- If the high forecast scenario were to materialize for reasons other than fuel price reductions, the stronger market (accelerated deliveries) could make the recovery of development costs possible, even if the aircraft were sold at a price below $28 million or if development and production costs were higher than those assumed in Appendix B.

Effects of Marketing and Financing Practices on Aircraft Supply

Airbus does not have the same ability as Boeing to expand or contract its workforce to meet market demand. The Airbus share is vulnerable in a rising

market because the level production policy will cause it to lose market share to Boeing who are able to adopt a flexible production policy. Boeing is, however, vulnerable to Airbus pricing in a weak market since Boeing, as a publicly-owned corporation, has more limited resources than Airbus and because the U.S. government support for concessionary financing has not tended to be as generous as the European support. Market share gains in a weak market are not as significant as the market share gains in a strong market. Consequently, the Airbus share is generally always less than Boeing's.

Anticipated Market Share Scenario

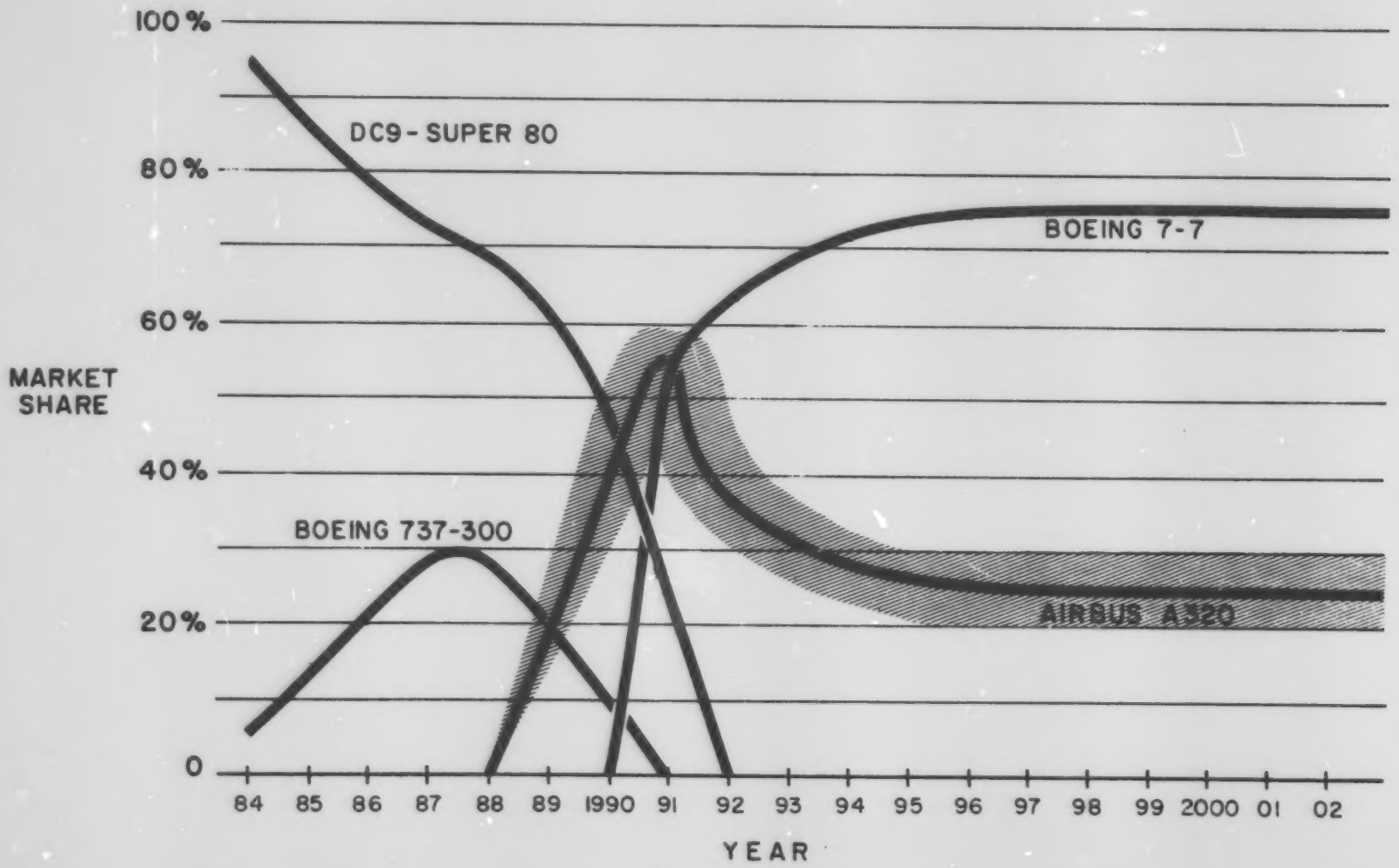
Our assessment of the anticipated strategies of Airbus, Boeing and McDonnell-Douglas results in the following scenario. Airbus will introduce an A320 into service in 1988. The A320 market share will rise rapidly as it displaces the Boeing 737-300 and the McDonnell-Douglas DC9-Super 80 Series. Boeing will introduce a 7-7 in 1990 as its answer to the A320. As a consequence of the Boeing 7-7 and A320 entries, the production of the 737-300 will cease after 1991 and the DC9-Super 80 Series after 1992. The Boeing 7-7 will likely be slightly better technically than the Airbus A320; however, because of a later entry date into the market it will have higher development costs and a slightly higher price associated with it. The anticipated better technical features of the Boeing 7-7 will allow it to gain a higher market share than the share dictated by political factors alone would warrant. The expected scenario of market shares for the various 150-seater aircraft by year is shown in Exhibit 37, opposite. The range of potential market shares for the Airbus A320 are shown as a shaded band. The market shares do not reflect the Airbus production constraints.

Effects of Airbus Production Constraints

Airbus, because of its inability to contract or expand the production of the A320 to meet market requirements, will miss some sales opportunities. As was

EXHIBIT 37

MARKET SHARES OF VARIOUS 150 SEATER AIRCRAFT (1984-2002)



SOURCE: Peat Marwick Analysis

discussed in Section 3, Airbus is unable to rapidly alter its production schedules because of national requirements to provide long-term steady employment. A production schedule, incorporating learning curve efficiencies, that allows Airbus to be generally at or below its potential market share and yet maintain a stable workforce, is shown in Exhibit 38, following. The assumed production schedule does not anticipate demand cycles. In poor demand years, Airbus, because of its tendency to provide lower pricing and better financing terms, will be able to clear the excess production. While the expected Airbus market share without production constraints is 29% in the period 1988-2002, Airbus production constraints reduce the anticipated market share by 3% to 26% of the world 150-seat aircraft market.

However, in a long-term up-market, Airbus could expand its production capacity and objectives, particularly if political implications develop to encourage Airbus to expect preferential treatment from an expanding range of nations acquiring aircraft. The anticipated market shares are therefore subject to a great deal of uncertainty.

4.2.2 Anticipated Market Shares

The market shares of the various 150-seater aircraft (Exhibit 37), adjusted by the 3% in Airbus share loss due to production constraints, when translated into world markets, result in the market shares shown in Exhibit 39. Exhibit 39 shows the anticipated market shares for 150-seat aircraft by time segment and world market for each aerospace manufacturer.

The market shares in Exhibit 39, following, when integrated with the requirements for new aircraft by area found in Exhibit 35, result in the expected market size for each single-aisle class and for each aircraft type within the 150-seater class by time segment shown in Exhibit 40, following.

EXHIBIT 38

EFFECTS OF AIRBUS PRODUCTION CONSTRAINTS ON A320 MARKET SHARE
(BASE TRAFFIC FORECAST)

Year	Requirement for New 150 Seat Aircraft*	Anticipated Demand for the A320 with no Airbus production Constraints**	Anticipated A320 Production Schedule
1988	146	15	22
1989	148	50	37
1990	151	76	42
1991	154	69	42
1992	157	54	45
1993	160	48	45
1994	167	47	45
1995	175	47	45
1996	184	47	50
1997	193	49	50
1998	198	50	50
1999	206	53	50
2000	214	54	56
2001	223	57	56
2002	231	59	56
Total	2634	775	690
Share		29%	26%

* Derived from Exhibit 35

** Derived from Exhibit 36 using "Expected" Airbus share

SOURCE: Peat Marwick Analysis

EXHIBIT 39

EXPECTED MARKET SHARES FOR 150-SEATER AIRCRAFT BY MANUFACTURER

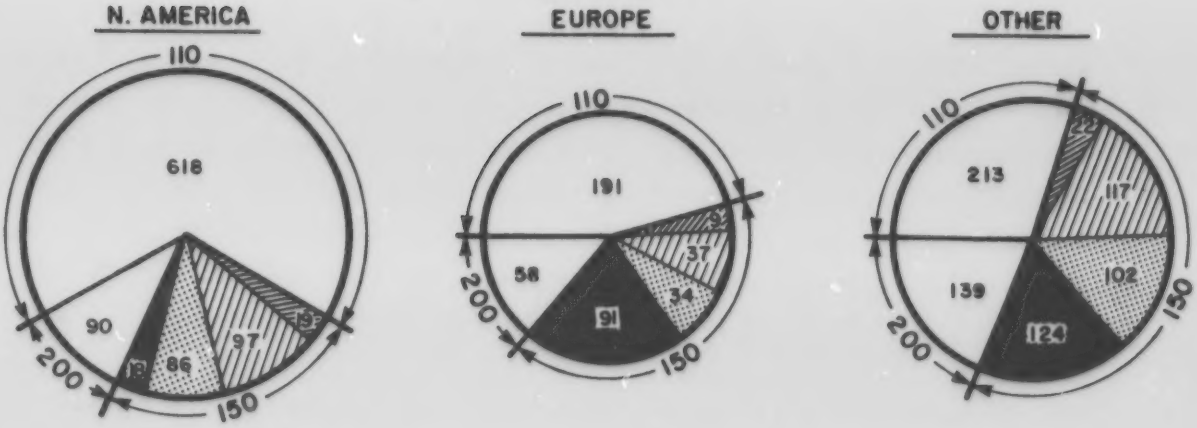
	Europe	N. America	Other	World
1988 - 1992				
Airbus	53%	8%	34%	29%
Boeing	27%	53%	38%	41%
McDonnell-Douglas	20%	39%	28%	30%
1993 - 1997				
Airbus	53%	8%	34%	27%
Boeing	47%	92%	67%	73%
McDonnell-Douglas	0%	0%	0%	0%
1998 - 2002				
Airbus	47%	7%	30%	25%
Boeing	53%	93%	70%	75%
McDonnell-Douglas	0%	0%	0%	0%

EXHIBIT 40

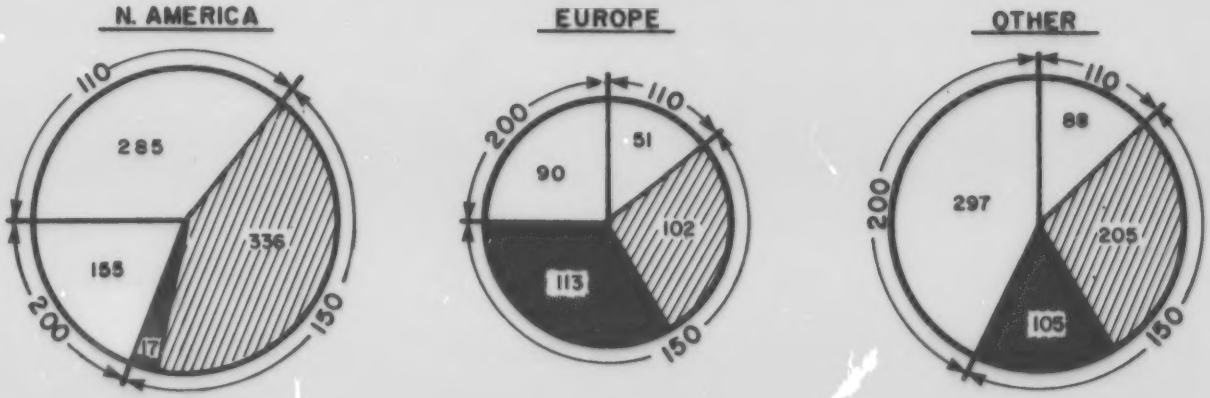
NEW AIRCRAFT REQUIREMENTS

BASE FORECAST, EXPECTED MARKET SHARE

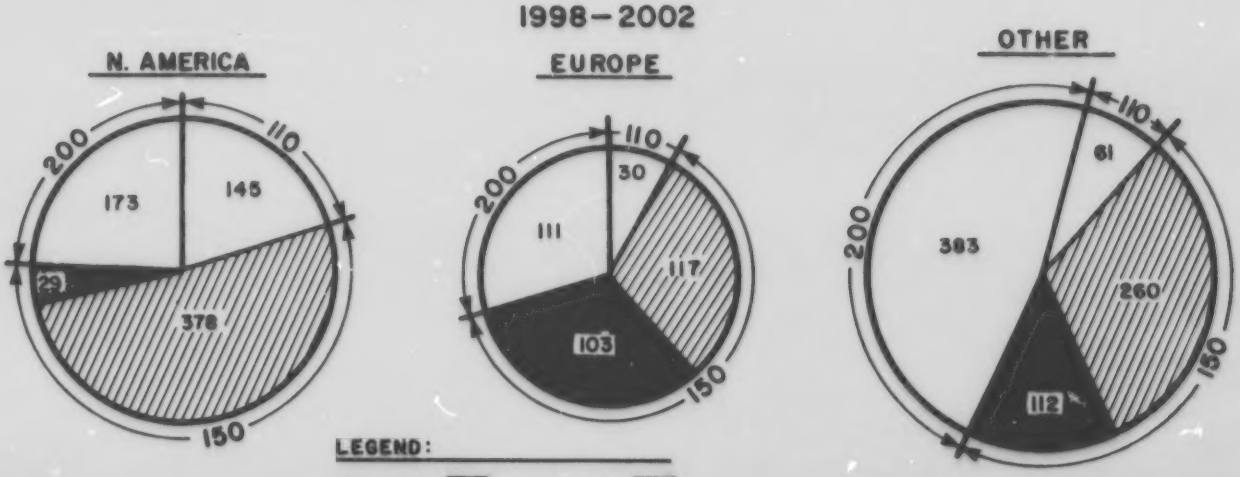
1988 - 1992



1993 - 1997



1998 - 2002



LEGEND:

737-300		DC9-80	
7-7		A320	

Airbus production constraints alter our assessment of the Airbus A320 share ranges elaborated on page 72. Our revised A320 market share ranges, recognizing the Airbus production constraints, are shown in Exhibit 41, following. Using our projection of requirements (base traffic forecast) for new 150-seater aircraft found in Exhibit 35, the revised market share ranges translate into the low, expected and high requirements for A320 aircraft for the periods 1982-1992, 1993-1997 and 1998-2002 found in Exhibit 42, following.

The projected 150-seat aircraft requirements for the low, base and high traffic growth scenarios (found in Exhibit 36) and the low, expected and high market share ranges for the A320 aircraft (found in Exhibit 39) translate into the A320 deliveries scenarios for the period 1988-2002 shown in Exhibit 43, following.

EXHIBIT 41

MARKET SHARE RANGES FOR THE AIRBUS A320

	Europe	N. America	Other	World
1988-1992				
Low	40%	4%	24%	21%
Expected	53%	8%	34%	29%
High	65%	12%	44%	37%
1993-1997				
Low	40%	4%	24%	20%
Expected	53%	8%	34%	27%
High	65%	12%	44%	36%
1998-2002				
Low	36%	4%	21%	18%
Expected	47%	7%	30%	25%
High	58%	11%	39%	32%

EXHIBIT 42

A320 REQUIREMENTS
LOW, EXPECTED AND HIGH SCENARIOS
(BASE TRAFFIC FORECAST)

	Europe	N. America	Other	World
1988-1992				
Low	68	9	88	165
Expected	91	18	124	233
High	111	26	161	298
1993-1997				
Low	86	14	74	174
Expected	113	17	105	235
High	140	42	136	318
1998-2002				
Low	79	16	78	173
Expected	103	29	112	244
High	128	45	145	318
1988-2002				
Low	233	39	240	512
Expected	307	64	341	712
High	379	113	442	934

EXHIBIT 43

A320 DELIVERY SCENARIOS

1988-2002

TRAFFIC FORECAST	MARKET SHARE		
	LOW	EXPECTED	HIGH
LOW	373	532	689
BASE	503	701	919
HIGH	647	910	1177

APPENDIX A

FORECAST OF SINGLE-AISLE AIRCRAFT SALES

The requirements for new aircraft to the year 2002 were forecast in three steps:

- Forecasting the demand for available seat-kilometres
- Forecasting the share of each aircraft class in future fleets
- Forecasting the numbers of new aircraft required, considering the present fleet and expected aircraft retirements.

Each step is briefly described below.

Demand for Available Seat-Kilometres

Growth in air traffic is the basic factor that will determine the requirements for new aircraft. However, no models have yet been developed that can produce a reliable forecast of worldwide air traffic on the basis of the projected economic growth of individual countries. Although econometric and market models exist for the forecasting of traffic within some of the countries, such as Canada, attempts to develop such models for forecasting traffic between countries have generally not been successful. For that reason, worldwide traffic is generally projected on the basis of observations of past trends, modified by judgement regarding the continuation of these past trends into the future.

The forecasts considered in this report are based on a review of credible work carried out by several organizations, such as the ICAO, the FAA and General Electric. The latter applied an imaginative approach to long term trend projections which produced remarkably good results when applied to past traffic.

Exhibits A1 and A2 show the ranges of traffic growth rates considered in this report. The upper bound of the range used for the 1982-1992 period corresponds broadly to recent ICAO and FAA projections. The rates for the 1992-2002 period are one percentage point lower.

The base forecast of annual growth rates is consistent with the General Electric projections, with some modifications as explained below. The worldwide growth rate projected by General Electric has been allocated to world sectors in consideration of past differences in relative growth rates.

The average worldwide growth rate resulting from the base forecast indicated in Exhibit A1 is slightly in excess of 5 percent for the 1982-1992 period. This is somewhat in excess of General Electric's 4.6 percent growth rate. It was thought that General Electric, in its model of time trends, omitted a factor that is becoming increasingly important with declining growth rates and that cannot be omitted at the low-growth end of the time scale: this is the growth of population. General Electric's model would end up with zero growth in the distant future, indicating a maturity of traffic worldwide. However, even at that stage, population will still grow and, therefore, even if individual travel is not increasing, total traffic will still increase. The omission of this factor, amounting to 1 to 2 percent, was not significant when traffic growth rates were in excess of 10 percent, but the factor will become important at the growth rates projected for the next twenty years.

It was assumed in this report that the growth rates of traffic will be identical to the growth rates of the required available seat kilometres. This implies that airlines will not expect load factors to increase significantly beyond the load factors on which the size of their existing fleets are based.

The forecasts resulting from the applications of the growth rates above are shown graphically in Exhibit A3.

Aircraft Mix

In this report, we have addressed only single-aisle ("narrow-bodied") jet aircraft with seating capacity of 85 to 220 seats*. These aircraft represent approximately 71 percent of the world's jet fleet.

To project the mix of single-aisle jet aircraft in future fleets we have divided this aircraft category into three groups, each designated by a "typical" seating capacity. Accordingly, the groups were designated as "110" "150", and "200". The world was divided into three major areas: North America, Europe and Other, excluding the Soviet Union and the Warsaw Pact countries.

Each present and known future aircraft type was assigned to one of the classes. The Boeing 727, the DC-9 Super 80 and the future A320 were assigned to the "150" class. The Boeing 757 and the few remaining single-aisle four-engine jets (with the exception of the stretched DC8) were assigned to the "200" class.

The relative shares of the three aircraft size classes in the single-aisle category were estimated in three steps:

---

* "Seating Capacity" is defined as all economy 32" pitch configuration. The DC8-60 series is excluded from the single-aisle category and included in the twin-aisle fleet.

(i) The projected growth in available seat kilometres was divided into two components: the growth in average seating capacity per aircraft and the growth in the number of aircraft.

(ii) The average seating capacity of each size class was estimated for 1987, 1992, 1997 and 2002.

(iii) The present relative proportions of the various size classes were adjusted in a reasonable manner, so as to obtain the overall average seating capacity projected in Step (i), in consideration of the average seating capacities in each size class as defined in Step (ii).

The process described above was iterative, so as to comply with all the defined constraints. The assumptions used in the process and the results are summarized below.

Exhibit A4 shows the division of the projected traffic growth rates into (1) the growth factors for average aircraft size and (2) the growth factors for the numbers of aircraft. The traffic growth rates correspond to the low forecast described in the previous Section.

The division of the growth rates between growth in size and growth in numbers was based on the observation of past data. These show, with considerable consistency, that in North America and Europe the growth in aircraft size (seating capacity) has been approximately equal to one-third of the growth rate of available seat-kilometres. As noted, it was assumed that the growth rate of available seat-kilometres was equal to the growth rate of traffic (revenue passenger-kilometres).

An adjustment was made to this observation to project average aircraft sizes in North America. Because of de-regulation, the systems environment is changing in the United States. The change is expected to result in a

substantial increase in the numbers of non-stop and direct routes between smaller airports and a de-emphasis of the previous hub-and-spoke system which favoured larger aircraft. The economies of a direct point-to-point service over the hub-and-spoke service can be clearly demonstrated wherever passenger traffic volumes warrant direct service. This change, coupled with the increasing number of competing carriers on individual routes, will tend to favour smaller aircraft. Therefore, it was assumed that the rate of growth in average aircraft size in North America will only be one quarter of the traffic growth rate instead of the historical one-third. The remainder of the growth will be provided by growth in the numbers of aircraft.

The growth rates of average aircraft sizes for world areas other than North America or Europe were originally assumed to be equal to those for Europe. These growth rates were subsequently increased, however, to a small extent in order to produce smoother aircraft replacement schedules which were considered to be more likely than the schedules resulting from the original assumptions.

Exhibit A5 shows the average aircraft sizes (seating capacities) within each size class projected for the years 1987, 1992, 1997 and 2002. The increase in passenger capacities recognizes:

- the retirement of older aircraft that are generally smaller than newer aircraft in each class

- the stretching of aircraft bodies that do not result, however, in the advancement of the aircraft into a higher class

- a better utilization of the remaining potential for denser seating.

The increase in average seating capacity within each size class is responsible for part of the projected growth in average size. The remainder of the

projected growth is caused by a changed mix of size classes within the single-aisle category.

Exhibit A6 shows the projected shares of each aircraft size class within the total fleets. These shares have been developed through an iterative process so as to arrive at both the projected overall average aircraft size for each of the years 1987, 1992, 1997 and 2002 for the total single-aisle category and to represent a reasonable replacement schedule on the other.

In constructing the tables in Exhibit A6, it was assumed that the single-aisle category in total will continue to represent the same total percentage of aircraft in the future fleets (including both jets and "feeder" propeller aircraft) of each world area as in 1981 - only the percentage share of each size classes within the single-aisle category will change. The share of future fleets represented by the twin-aisle category will probably increase slightly in the future, as a result of a decrease in the percentage of aircraft in the "feeder" category.

Forecasting the Needs for New Aircraft

The results of the preceding analysis make it possible to project the aircraft fleets that might be expected to operate in the three major world areas. However, in order to translate these projections into requirements for new aircraft, the retirement schedule for existing aircraft must be predicted.

This prediction was carried out by assuming that every aircraft delivered in a particular year would be fully operational for 16 years. In the 17th year the average aircraft would only fly 90 percent of the kilometres that it flew, on average, during the first 16 years. In the 18th year the aircraft would fly only 80 percent of that standard and so forth, until the 25th year in which it will fly only 10 percent. At the end of that year the aircraft would be scrapped. Although deviations from this pattern will, of course, occur, it was felt that the described pattern reflects the actual retirement schedules reasonably well.

Exhibit A7 shows the decline of total available tonne-kilometres performed by those aircraft that already exist in 1982. The Exhibit also shows the forecast requirements for tonne-kilometres; the difference between the two curves indicates the requirements for new capacity.

Curves similar to those shown in Exhibit A7 were developed for each aircraft class. This made it possible to complete Exhibits A8.1 to A8.12 which show the requirements for new single-aisle aircraft between the beginning of 1982 and the end of the years 1987, 1992, 1997 and 2002 respectively. Exhibits A8.1 to A8.12 contain references to previous exhibits showing the method by which the numbers of aircraft in each forecast year were predicted in each of the aircraft size classes. The projections were carried out for each world area.

Following these projections, the requirements for new aircraft were projected by subtracting the expected numbers of unretired aircraft that were in operation on January 1, 1982 that will not yet be retired before the end of the forecast year. This projection was carried out by using attrition curves (aircraft retirements) for individual aircraft classes, similar to the overall curve of Exhibit A7.

The final results of the process shown in Exhibits A8.1 to A8.12 are summarized in Exhibits A9 and A10. Exhibit A9 shows the predicted single-aisle fleets by size class. Exhibit A10 shows the net requirements for new aircraft in each 5-year period from 1988 (inclusive) to 2002, by size class and world area. The contents of Exhibit A10 are shown graphically in Exhibit A11.

Exhibit A10 clearly indicates the potential total market for the "150" class new aircraft between 1988 and 2002. It is this market in which the Airbus A320 has to compete, initially.

High and Low Forecast Scenarios

The preceding analysis was based on the base forecast scenario, developed by using the base traffic growth rates indicated in Exhibits A1 and A2.

The low and high forecast scenarios when applied to the 150 seat aircraft class result in the requirements for new aircraft shown in Exhibit A11.

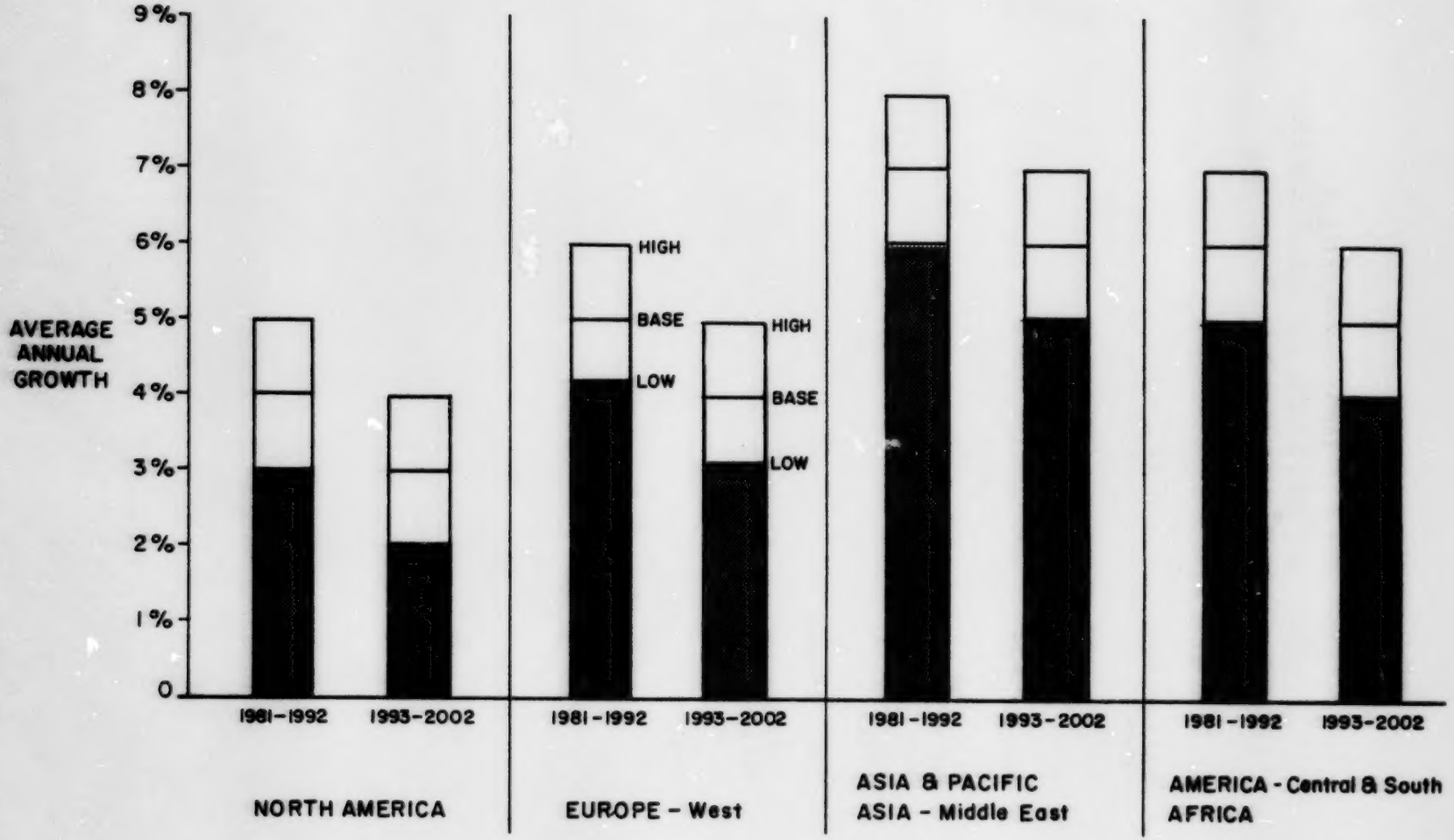
EXHIBIT A1

ANNUAL GROWTH RATES OF REQUIRED AVAILABLE SEAT-KILOMETERS

	1982-1992	1992-2002	1982-2002
Low Forecast			
North America	3%	2%	
Europe	4%	3%	
Other	5.7%	4.7%	
WORLD			3.8%
Base Forecast			
North America	4%	3%	
Europe	5%	4%	
Other	6.7%	5.7%	
WORLD			4.8%
High Forecast			
North America	5%	4%	
Europe	6%	5%	
Other	7.7%	6.7%	
WORLD			5.8%

EXHIBIT A2

FORECAST TRAFFIC GROWTH RATES - BY GEOGRAPHIC REGION



SOURCE: PEAT MARWICK ANALYSIS

EXHIBIT A3

HISTORICAL AND PROJECTED TONNE-KILOMETRES

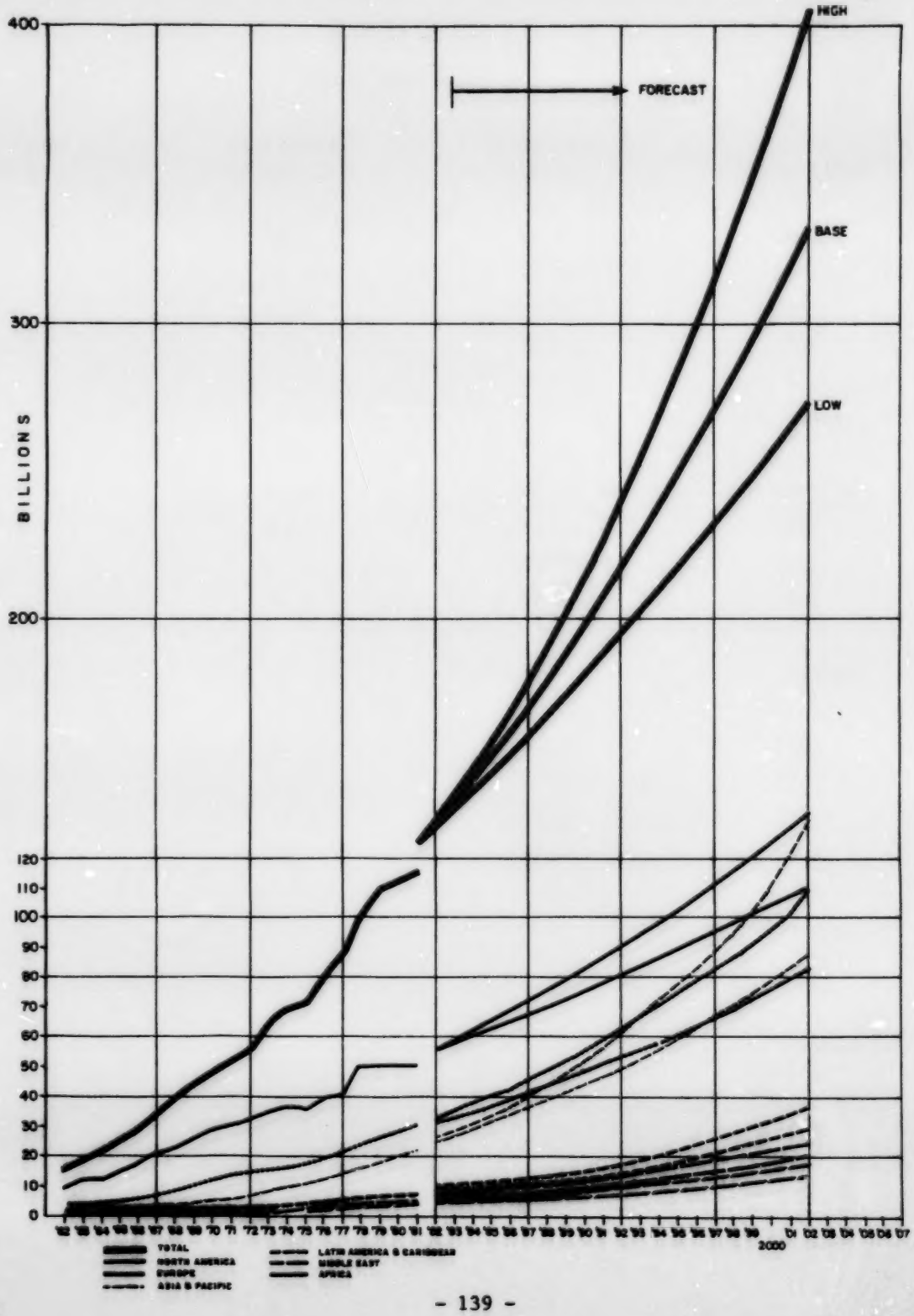


EXHIBIT A4

GROWTH FACTORS

(BASE FORECAST)

North America	Growth in Traffic	Growth in Aircraft Size	Growth in Numbers of Aircraft
1987	1.27	1.08	1.18
1992	1.54	1.14	1.35
1997	1.79	1.20	1.49
2002	2.07	1.27	1.63
Europe			
1987	1.34	1.12	1.20
1992	1.71	1.24	1.38
1997	2.08	1.35	1.54
2002	2.52	1.44	1.75
Other			
1987	1.48	1.14	1.30
1992	2.04	1.26	1.62
1997	2.70	1.37	1.97
2002	3.57	1.45	2.46

EXHIBIT A5

SINGLE-AISLE AIRCRAFT

SEATING CAPACITIES

	AVERAGE SEATING CAPACITY			OVERALL AVERAGE SEATING OF SINGLE-AISLE FLEETS		
	"110"	"150"	"200"	North America	Europe	Other
1981	100	125	150	117	108	112
1987	110	140	170	126	131	128
1992	120	150	180	134	135	142
1997	125	155	185	141	146	153
2002	130	160	190	149	156	163

EXHIBIT A6

PERCENTAGE SHARES OF AIRCRAFT CLASSES

GENERIC CLASS

	"110"	"150"	"200"	Total
North America				
1981	28%	45%	3%	76%
1987	38	35	3	76
1992	44	28	4	76
1997	42	27	7	76
2002	39	27	10	76
Europe				
1981	50%	18%	3%	71%
1987	47	20	4	71
1992	41	24	6	71
1997	31	30	10	71
2002	24	33	14	71
Other				
1981	37%	23%	4%	64%
1987	32	25	7	64
1992	26	29	9	64
1997	19	30	15	64
2002	14	30	20	64

EXHIBIT A7

HISTORICAL AND PROJECTED AVAILABLE SEAT KILOMETRES

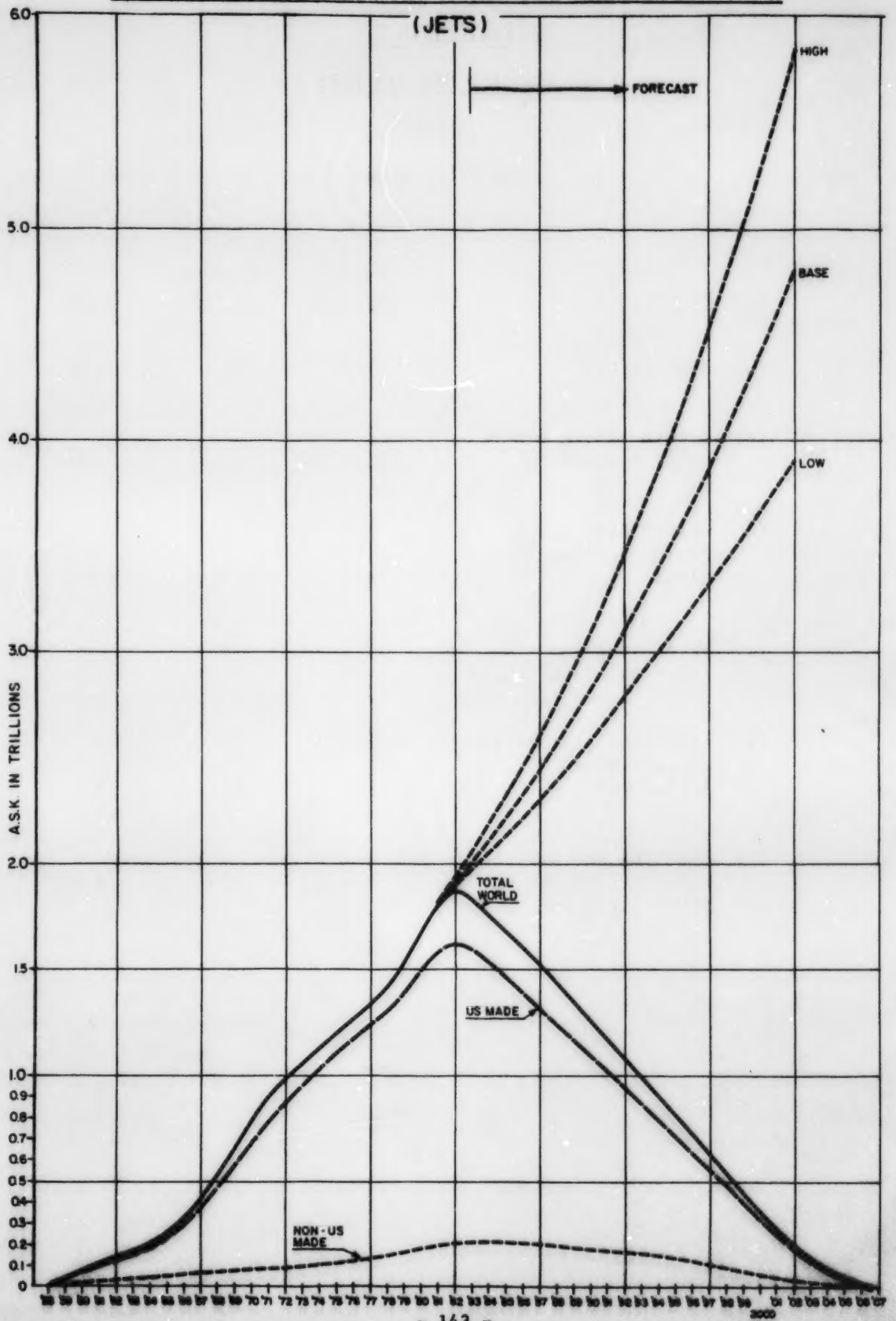


EXHIBIT A8.1

REQUIRED NEW AIRCRAFT

IN 1987

FOR "110" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	759	629	675
(b)	Growth Factor for Total Numbers:	1.18	1.20	1.30
(c)	Growth Factor for Share of Class in Fleet:	1.36	0.94	0.86
(d)	Fleet in 1987: (d) = (a) x (b) x (c)	1218	710	755
(e)	Less Remaining Portion of 1981 Fleet (77 % x (a)):	584	484	520
(f)	Required New Aircraft Between 1982 and 1987: (f) = (d) - (e)	634	225	235

EXHIBIT A8.2

REQUIRED NEW AIRCRAFT

IN 1992

FOR "110" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	759	629	675
(b)	Growth Factor for Total Numbers:	1.35	1.38	1.62
(c)	Growth Factor for Share of Class in Fleet:	1.57	0.82	0.70
(d)	Fleet in 1992: (d) = (a) x (b) x (c)	1609	712	765
(e)	Less Remaining Portion of 1981 Fleet (47% x (a)):	357	296	317
(f)	Required New Aircraft Between 1982 and 1992: (f) = (d) - (e)	1252	416	448

EXHIBIT A8.3

REQUIRED NEW AIRCRAFT

IN 1997

FOR "110" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	759	629	675
(b)	Growth Factor for Total Numbers:	1.49	1.54	1.97
(c)	Growth Factor for Share of Class in Fleet:	1.50	0.62	0.51
(d)	Fleet in 1997: (d) = (a) x (b) x (c)	1696	601	678
(e)	Less Remaining Portion of 1981 Fleet (21% x (a)):	159	132	142
(f)	Required New Aircraft Between 1982 and 1997: (f) = (d) - (e)	1537	469	536

EXHIBIT A8.4

REQUIRED NEW AIRCRAFT

IN 2002

FOR "110" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	759	629	675
(b)	Growth Factor for Total Numbers:	1.63	1.75	2.46
(c)	Growth Factor for Share of Class in Fleet:	1.39	0.48	0.38
(d)	Fleet in 2002 : (d) = (a) x (b) x (c)	1720	528	631
(e)	Less Remaining Portion of 1981 Fleet (05% x (a)):	38	31	34
(f)	Replacement of New Aircraft Introduced Between 1981 and 1987 (25%):	159	56	59
(g)	Required New Aircraft Between 1982 and 2002: (g) = (d) - (e) + (f)	1841	553	656

EXHIBIT A8.5

REQUIRED NEW AIRCRAFT

IN 1987

FOR "150" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	1229	224	413
(b)	Growth Factor for Total Numbers:	1.18	1.20	1.30
(c)	Growth Factor for Share of Class in Fleet:	0.78	1.11	1.09
(d)	Fleet in 1987: (d) = (a) x (b) x (c)	1131	298	585
(e)	Less Remaining Portion of 1981 Fleet (77% x (a)):	946	172	318
(f)	Required New Aircraft Between 1982 and 1987: (f) = (d) - (e)	182	126	267

EXHIBIT A8.6

REQUIRED NEW AIRCRAFT

IN 1992

FOR "150" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	1229	224	413
(b)	Growth Factor for Total Numbers:	1.35	1.38	1.62
(c)	Growth Factor for Share of Class in Fleet:	0.62	1.33	1.26
(d)	Fleet in 1992: (d) = (a) x (b) x (c)	1029	411	843
(e)	Less Remaining Portion of 1981 Fleet (51% x (a)):	627	114	211
(f)	Required New Aircraft Between 1982 and 1992 : (f) = (d) - (e)	402	297	632

EXHIBIT A8.7

REQUIRED NEW AIRCRAFT

IN 1997

FOR "150" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	1229	224	413
(b)	Growth Factor for Total Numbers:	1.49	1.54	1.97
(c)	Growth Factor for Share of Class in Fleet:	0.60	1.67	1.30
(d)	Fleet in 1997: (d) = (a) x (b) x (c)	1099	567	1058
(e)	Less Remaining Portion of 1981 Fleet (28% x (a)):	344	63	116
(f)	Required New Aircraft Between 1982 and 1997: (f) = (d) - (e)	755	513	942

EXHIBIT A8.8

REQUIRED NEW AIRCRAFT

IN 2002

FOR "150" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	1229	224	413
(b)	Growth Factor for Total Numbers:	1.63	1.75	2.46
(c)	Growth Factor for Share of Class in Fleet:	0.60	1.83	1.30
(d)	Fleet in 2002: (d) = (a) x (b) x (c)	1202	717	1321
(e)	Less Remaining Portion of 1981 Fleet (07% x (a)):	86	16	29
(f)	Replacement of New Aircraft Introduced Between 1981 and 1987 (25%):	46	32	22
(g)	Required New Aircraft Between 1982 and 2002: (g) = (d) - (e) + (f)	1162	733	1314

EXHIBIT A8.9

REQUIRED NEW AIRCRAFT

IN 1987

FOR "200" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	86	36	77
(b)	Growth Factor for Total Numbers:	1.18	1.20	1.30
(c)	Growth Factor for Share of Class in Fleet:	1.0	1.33	1.75
(d)	Fleet in 1987: (d) = (a) x (b) x (c)	101	57	175
(e)	Less Remaining Portion of 1981 Fleet (61% x (a)):	52	22	47
(f)	Required New Aircraft Between 1982 and 1987: (f) = (d) - (e)	49	35	128

EXHIBIT A8.10

REQUIRED NEW AIRCRAFT

IN 1992

FOR "200" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	86	36	77
(b)	Growth Factor for Total Numbers:	1.35	1.38	1.62
(c)	Growth Factor for Share of Class in Fleet:	1.33	2.0	2.25
(d)	Fleet in 1992: (d) = (a) x (b) x (c)	154	99	281
(e)	Less Remaining Portion of 1981 Fleet (18% x (a)):	15	6	14
(f)	Required New Aircraft Between 1982 and 1992: (f) = (d) - (e)	139	93	267

EXHIBIT A8.11

REQUIRED NEW AIRCRAFT

IN 1997

FOR "200" CLASS

		North America	Western Europe	Other
(a)	1981 Fleet:	86	36	77
(b)	Growth Factor for Total Numbers:	1.49	1.54	1.97
(c)	Growth Factor for Share of Class in Fleet:	2.33	3.33	3.75
(d)	Fleet in 1997: (d) = (a) x (b) x (c)	299	185	569
(e)	Less Remaining Portion of 1981 Fleet (06% x (a)):	5	2	5
(f)	Required New Aircraft Between 1982 and 1997 : (f) = (d) - (e)	294	183	564

EXHIBIT A8.12

REQUIRED NEW AIRCRAFT

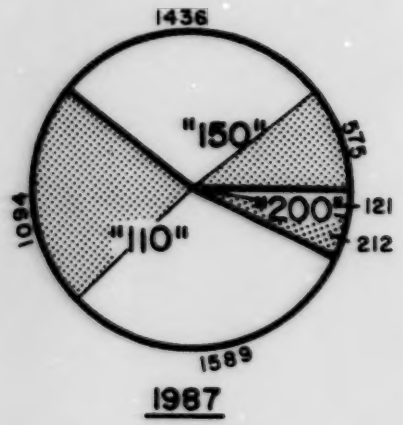
IN 2002

FOR "200" CLASS

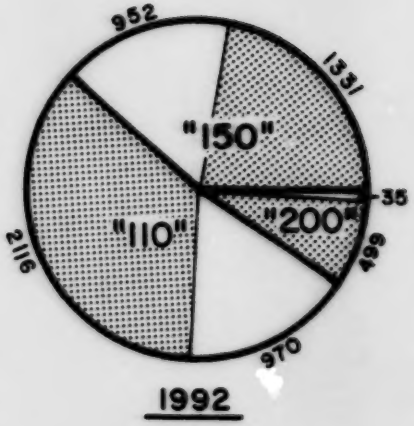
		North America	Western Europe	Other
(a)	1981 Fleet:	86	36	77
(b)	Growth Factor for Total Numbers:	1.63	1.75	2.46
(c)	Growth Factor for Share of Class in Fleet:	3.33	4.67	5.0
(d)	Fleet in 2002: (d) = (a) x (b) x (c)	467	294	947
(e)	Less Remaining Portion of 1981 Fleet (0% x (a)):	0	0	0
(f)	Replacement of New Aircraft Introduced Between 1981 and 1987 (25%):	12	9	32
(g)	Required New Aircraft Between 1982 and 2002: (g) = (d) - (e) + (f)	479	303	979

EXHIBIT A-9

PROJECTED WORLD SINGLE-AISLE AIRCRAFT FLEETS*



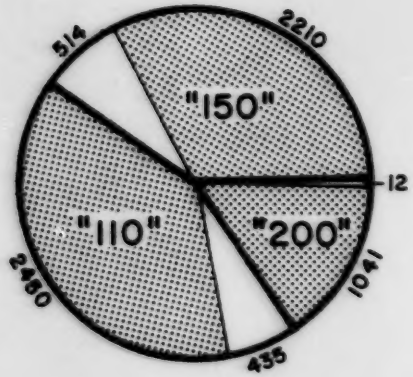
1987



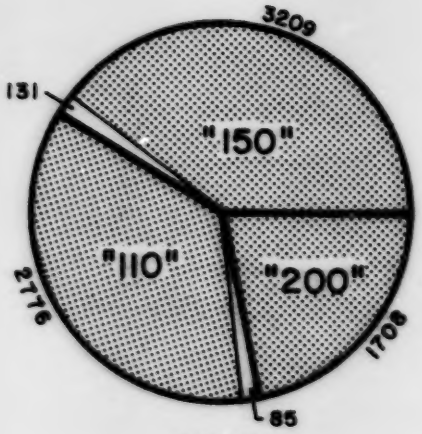
1992

LEGEND

AIRCRAFT PURCHASED AFTER 1981



1997



2002

* AT END OF YEAR SHOWN

EXHIBIT A10

REQUIREMENTS FOR NEW SINGLE-AISLE AIRCRAFT BY AREA
(BASE FORECAST)

	1988-1992	1993-1997	1998-2002	Total
North America				
"110"	618	285	145	1048
"150"	220	353	407	980
"200"	90	155	173	418
Total	928	793	725	2446
Europe				
"110"	191	51	30	272
"150"	171	216	220	607
"200"	58	90	111	259
Total	420	357	361	1138
Other				
"110"	213	88	61	362
"150"	365	310	372	1047
"200"	139	297	383	819
Total	717	695	816	2228
World				
"110"	1022	424	236	1682
"150"	756	879	999	2634
"200"	287	542	667	1469
Total	2065	1845	1902	5812

EXHIBIT A11

REQUIREMENTS FOR NEW "150" SEAT AIRCRAFT
(LOW, BASE AND HIGH TRAFFIC GROWTH FORECAST)

	N. America	Europe	Other	Total
1988-1992				
Low Forecast	187	125	318	630
Base Forecast	220	171	365	756
High Forecast	273	198	411	882
1993-1997				
Low Forecast	305	143	232	680
Base Forecast	353	216	310	879
High Forecast	416	265	398	1079
1998-2002				
Low Forecast	322	127	269	718
Base Forecast	407	220	372	999
High Forecast	510	294	538	1342
1988-2002				
Low Forecast	814	395	819	2028
Base Forecast	980	607	1047	2634
High Forecast	1199	757	1347	3303

APPENDIX B

THE COMPETITIVE POSITION OF THE AIRBUS A320 AIRCRAFT

An important factor in the development of market share projections is an understanding of the expected economic advantages of a particular product to its user. When airlines make their aircraft purchase decisions, economic performance is usually the most important issue examined.

In this study, we attempted to simulate the financial analysis that an airline would perform when deciding whether to purchase an A320 or another similarly sized aircraft.

The main competitors to the A320 (with CFM56-4 engines) currently are the DC9 Super 80 (with Pratt & Whitney JT8D-209 or JT8D-217 engines) and the Boeing 737-300 (with CFM56-3 engines). Based on a comparable single-class seating arrangement (32 inch pitch), the Boeing 737-300 can seat 137 passengers, the DC9 Super 80 can seat 152 passengers, and the A320, according to the February 1983 announcement, 158 passengers. These aircraft would be considered by a carrier needing an aircraft with a passenger capacity somewhere between 130 and 170 passengers.

Fuel consumption is one of the major elements in the estimation of financial performance. The data for this parameter were derived from the published payload/range diagrams (see Exhibit B1 for a typical payload/range diagram) of each aircraft type.

The "middle" portions of payload/range diagrams pertain to the case of a maximum weight* aircraft (starting its trip at maximum takeoff weight). In this

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* Weight consists of payload (passenger and cargo) + fuel load + weight of empty aircraft.

portion, payload is replaced by fuel to increase flying distance. The diagrams show how much further an aircraft can fly at the expense of a loss in payload and a corresponding increase in fuel weight. The slopes of the payload/range diagrams clearly indicate the relationships between the amount of fuel added and the extra distance travelled, i.e. the fuel consumption per mile of a maximum-weight aircraft.

The approximation can be made that, within certain limits, the consumption of fuel is directly proportional to the weight of an aircraft. In precise terms there is some loss of engine efficiency when the actual aircraft weight is different from the weight associated with maximum engine efficiency. However, the assumption of proportionality between fuel consumption and weight can be used for broad calculations to indicate the increase in fuel consumption per mile when the stagelength (non-stop distance between two airports) is increased. An aircraft has to start with more fuel, and consequently carry more weight, when the stagelength is increased.

Using this approach, Exhibits B2 and B3 were prepared to simulate a scenario in which the A320 would be most favoured (Exhibit B2), and a scenario in which it would be least favoured (Exhibit B3), using reasonable assumptions.

All the figures in Exhibits B2 and B3 are in 1983 constant U.S. dollars. In the first scenario, see Exhibit B2, a fuel price of $1.30 per U.S. gallon, a stagelength of 1,500 nautical miles and a real* interest** rate of 6 percent were assumed. In the second scenario, see Exhibit B3, a fuel price of $0.90 per U.S. gallon, a stagelength of 500 nautical miles and a real interest rate of 10 percent were assumed.

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* "Real" means net of inflation rate.

** "Interest" (or cost of capital) means a blend between the airline's interest rate on debt and its pre-tax rate of return on equity.

It was assumed that a typical aircraft in the "150" class is used 3,000 block-hours per year.

Our previous studies indicate that the average fuel consumption per block hour of an aircraft is very close to the average hourly fuel consumption while cruising.

Two adjustments were made to the fuel consumption estimates. First, it was recognized that airlines would evaluate an aircraft carrying a "typical" load rather than an aircraft carrying the maximum possible weight when calculating the fuel savings potential of the aircraft. It was estimated that at a 65 percent load factor, an aircraft would consume approximately 10 percent less fuel than at maximum weight and, therefore, the savings would be reduced to this extent. Since the load factor was applied equally to all aircraft, this reduction has relatively little impact on the perceived difference between fuel efficiencies of each aircraft. Airlines, in their calculations, are likely to make similar assumptions.

The second adjustment resulted in a small increase in the fuel consumption estimates for the A320 aircraft. Published data for this aircraft imply airframe efficiency improvements that may be somewhat optimistic in light of the airframe efficiencies attained by other recently introduced aircraft, including the A310. We accepted two-thirds of the airframe efficiency improvement indicated in the A320 literature.

The impact of future engine improvements was not considered since such improvements will likely be applied not only to the CFM56-4 engine but also to the CFM56-3 and other engines.

Maintenance costs and flight crew costs were assumed to be identical for all aircraft types considered. These costs were conservatively estimated to be $2.5 million per year. Although maintenance labour costs may be somewhat lower for more advanced engines, the parts for such engines are usually more costly, compensating for any labour savings. Flight crew costs may depend

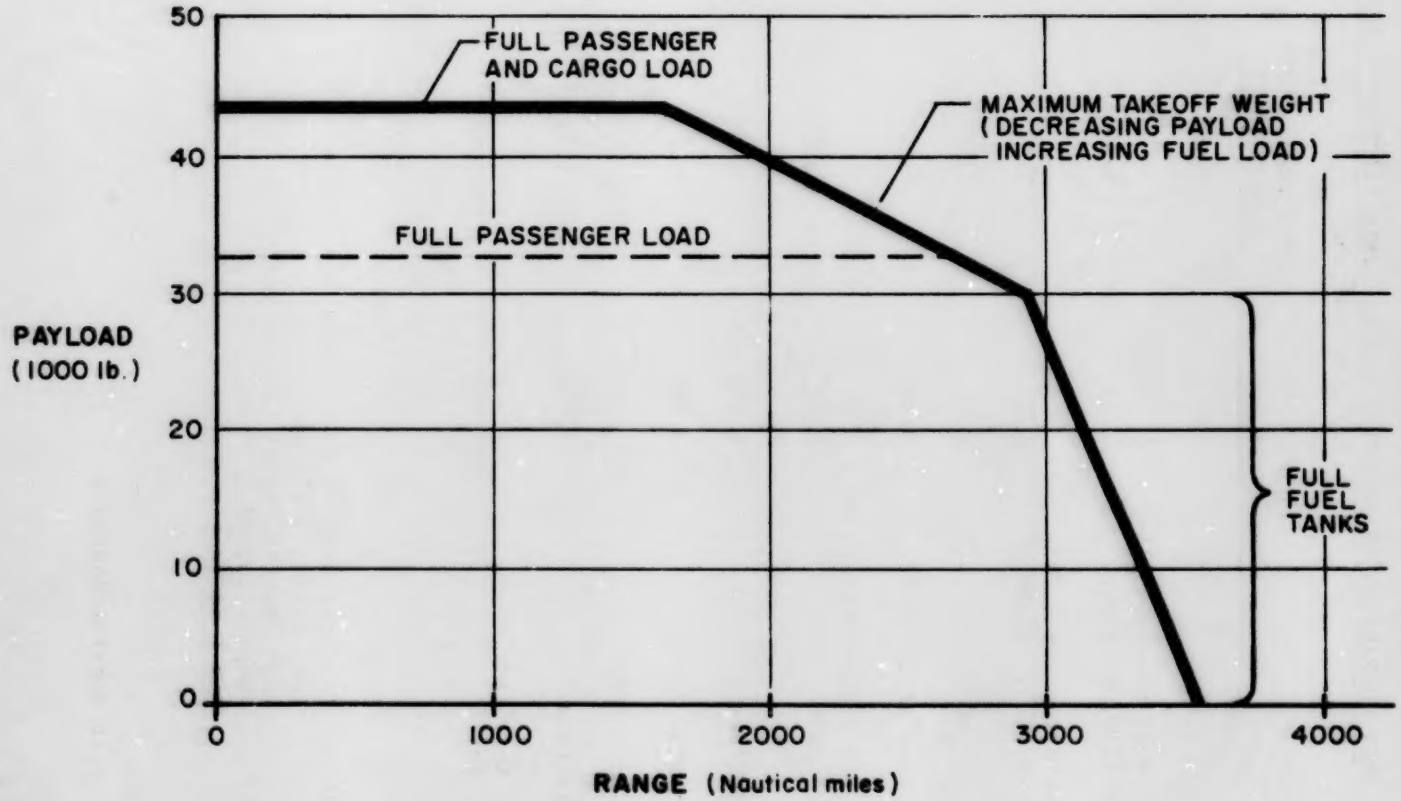
slightly on aircraft type; however, these differences were not considered to be significant. All other operating costs are independent of aircraft type and depend strictly on the number of passengers, passenger-kilometres or cargo tonnes.

With these assumptions, the net present value (NPV) of direct operating costs (fuel, flight crew and maintenance) was calculated using a 15-year time horizon. The estimated capital cost of the aircraft was then added and the sum divided by the number of seats to arrive at a "present cost" per seat. The "breakeven" capital cost of the A320 aircraft was defined as the cost that would produce exactly the same "present cost" per seat as the A320's closest competitor: the DC9 Super 80.

It was found that the "breakeven" capital cost of the A320, calculated in this manner, was $31.4 million in the favourable scenario (see Exhibit B2) and $27.7 million in the unfavourable scenario (see Exhibit B3). This means that if the price of the A320 was higher than $31.4 million, very few carriers would buy the A320, but if the price was lower than $27.7 million, the A320 could have a substantial market share.

EXHIBIT B-1

PAYLOAD / RANGE - A320



Long Range Cruise - 37,000 feet
ISA, Zero wind.

Reserves:
200 nmi diversion
45 minute continued cruise

SOURCE : AIRBUS INDUSTRIE

EXHIBIT B2

COST COMPARISON OF SELECTED SINGLE-AISLE AIRCRAFT - SCENARIO 1

(1983 U.S. dollars)

	737-300 (CFM56-3)	DC9 Super 81/82 (JT8D-209/217)	A320 (CFM56-4)
Seats	137	152	158
Specific Fuel Consumption (U.S. gal/100,000 lb/NM)	1.51	1.60	1.31
Fuel Consumption on a Trip of 1500 NM (U.S. gal/NM)	1.7	2.0	1.65
$/Hour	1016	1196	987
$MM per year at 3000 hrs	3.048	3.588	2.960
Flight crew and maintenance ($MM/year)	2.500	2.500	2.500
Total ($MM/year)	5.548	6.088	5.460
Present Value ($MM)	53.882	59.127	52.900
Capital Cost ($MM)	20.000	22.000	31.470
Total NPV ($MM)	73.882	81.127	84.370
"Present Cost" per seat ($/Seat)	540,000	534,000	534,000

Assumptions: Cost per seat of A320 = Cost per seat of DC9-Super 80
Fuel Price: $1.30/gal.
Real Interest Rate: 6% - 15 year life
Range: 1500 NM
65% load factor

Source: Peat Marwick Analysis

EXHIBIT B3

COST COMPARISON OF SELECTED SINGLE-AISLE AIRCRAFT - SCENARIO 2
(1983 U.S. dollars)

	737-300 (CFM56-3)	DC9 Super 81/82 (JT8D-209/217)	A320 (CFM56-4)
Seats	137	152	158
Specific Fuel Consumption (U.S. gal/100,000 lb/NM)	1.51	1.60	1.31
Fuel Consumption on a Trip of 500 NM (U.S. gal/NM)	1.6	1.9	1.55
$/Hour	662.40	786.60	641.70
$MM per year at 3000 hrs	1.987	2.358	1.925
Flight crew and maintenance ($MM/year)	2.500	2.500	2.500
Total ($MM/year)	4.487	4.858	4.425
Present Value ($MM)	34.128	36.950	33.630
Capital Cost ($MM)	19.000	22.000	27.670
Total NPV ($MM)	53.128	58.950	61.300
"Present Cost" per seat ($/Seat)	390,000	388,000	388,000

Assumptions: Cost per seat of A320 = Cost per seat of DC9-Super 80
Fuel Price: $0.90/gal.
Real Interest Rate: 10% - 15 year life
Range: 500 NM
65% load factor

Source: Peat Marwick Analysis

APPENDIX C

GLOSSARY OF TERMS EMPLOYED

Airbus	-	Airbus Industrie
Aircraft Designations	-	referred to by their commonly accepted numbers without the use of the manufacturer's name, i.e.: . 757 refers to the Boeing 757 . A320 refers to the Airbus A320 . DC9-80 refers to the McDonnell-Douglas DC9-80
Narrow-Body or Single-Aisle	-	aircraft with seating up to six passengers abreast in standard economy seating single-aisle configuration
Wide-body	-	aircraft seating more than six passengers abreast in standard economy seating twin-aisle configuration
110 Seat Generic Class	-	narrow-body aircraft with a passenger seating capacity of between 80 and 140
150 Seat Generic Class	-	narrow-body aircraft with a passenger seating capacity of between 140 and 170
200 Seat Generic Class	-	narrow-body aircraft with a passenger seating capacity of between 170 and 220
220 Seat Generic Class	-	wide-body aircraft with a passenger seating capacity of between 200 and 240
250 Seat Generic Class	-	wide-body aircraft with a passenger seating capacity of between 240 and 270
350 Seat Generic Class	-	wide-body aircraft with a passenger seating capacity of between 270 and 350
400 Seat Generic Class	-	wide-body aircraft with a passenger seating capacity of between 350 and 550
Single-Aisle Aircraft Segment	-	an aircraft class comprised of the 110 seat, 150 seat and 200 seat generic classes
Twin-Aisle Twin Engine Aircraft Segment	-	an aircraft class comprised of the 220 seat and 250 seat generic classes
Twin-Aisle Multi-Engine Aircraft Segment	-	an aircraft class comprised of the 350 and 400 seat generic classes

GLOSSARY OF TERMS EMPLOYED cont'd

Operating Profits	-	operating revenues less operating expenses
Thrust	-	the force exerted by the rearward ejection of gases from a jet engine
150 Seater	-	an aircraft with a passenger seating capacity of 140 to 170
SBU	-	Strategic Business Unit. An SBU is a distinct business within a business with different missions, concepts, competitors, technologies, markets and financial requirements
Business Portfolio	-	a collection of strategically separable businesses classified according to the industry attractiveness of each business and the competitive position of each business
Product Portfolio	-	a collection of distinct product lines. Each product line is classified in a matrix by the product's rate of growth relative to GNP growth and the competitive position of the product (market share and product's position on the product life cycle)
Product Growth	-	annual rate of growth in constant dollars of each product in a product portfolio relative to GNP growth
Market Share (Product Portfolio)	-	market share of a product relative to sales of aircraft in either the single-aisle, twin aisle-twin engine or twin-aisle multi-engine aircraft segments
Derivative	-	a major modification to the airframe of an aircraft, such as a stretched fuselage or modified wings, but not a total redesign of the aircraft
Average Stage Length	-	the average stagelength flown per aircraft computed by dividing the aircraft kilometres flown by the related number of aircraft departures

GLOSSARY OF TERMS EMPLOYED cont'd

Available Seat Kilometres	-	a seat kilometre is available when a seat is flown one kilometre. Seat kilometres available are equal to the sum of the products obtained by multiplying the number of passenger seats available for sale on each flight stage by the stagelength.
Tonne Kilometre	-	A metric tonne of revenue load carried one kilometre. Tonne kilometres performed equals the sum of the products obtained by multiplying the number of tonnes of revenue load carried on each flight stage by the stage length. One passenger = 180 kg.
Passenger load factor	-	Passenger-kilometres performed as a percentage of available seat-kilometres

APPENDIX D

STRATEGIC POSITION AND ACTION EVALUATION

A) INDUSTRY ASSESSMENT - ENVIRONMENTAL STABILITY

B) INDUSTRY ASSESSMENT - INDUSTRY STRENGTH

C) COMPANY ASSESSMENT - COMPETITIVE ADVANTAGE

Airbus Industrie
Boeing
McDonnell-Douglas

D) COMPANY ASSESSMENT - FINANCIAL STRENGTH

Airbus Industrie
Boeing
McDonnell-Douglas

Industry Assessment

Factors determining environmental stability

Technological changes	Many	0	1	(2)	3	4	5	6	Few
Rate of inflation	High	0	1	2	(3)	4	5	6	Low
Demand variability	Large	0	1	(2)	3	4	5	6	Small
Price range of competing products	Wide	0	1	2	3	4	(5)	6	Narrow
Barriers to entry into market	Few	0	1	2	3	4	5	(6)	Many
Competitive pressure	High	(0)	1	2	3	4	5	6	Low
Price elasticity of demand	Elastic	0	1	2	3	4	(5)	6	Inelastic

Average − 6 = $\underline{23 \div 7 = 3.3 - 6}$ = −2.7

Industry Assessment

Factors determining industry strength

Growth potential	Low	0	1	2	3	4	(5)	6	High
Profit potential	Low	0	1	2	(3)	4	5	6	High
Financial stability	Low	0	1	2	(3)	4	5	6	High
Technological know-how	Simple	0	1	2	3	4	5	(6)	Complex
Resource utilization	Inefficient	0	1	2	3	(4)	5	6	Efficient
Capital intensity	High	(0)	1	2	3	4	5	6	Low
Ease of entry into market	Easy	0	1	2	3	4	5	(6)	Difficult
Productivity, capacity utilization	Low	0	1	2	3	(4)	5	6	High

Average $31 \div 8 = 3.75$

Airbus Industrie

Company Assessment

Factors determining competitive advantage

Market share	Small	0	1	2	(3)	4	5	6	Large
Product quality	Inferior	0	1	2	3	4	(5)	6	Superior
Product life cycle	Late	0	1	2	3	4	5	(6)	Early
Product replacement cycle	Variable	0	1	2	3	(4)	5	6	Fixed
Customer loyalty	Low	0	1	2	(3)	4	5	6	High
Competition's capacity utilization	Low	0	1	2	3	4	(5)	6	High
Technological know-how	Low	0	1	2	3	4	5	(6)	High
Vertical integration	Low	0	1	2	3	4	5	(6)	High

Average − 6 = $\underline{38 \div 8 - 6} = -1.25$

Boeing

Company Assessment

Factors determining competitive advantage

Market share	Small	0	1	2	3	4	(5)	6	Large
Product quality	Inferior	0	1	2	3	(4)	5	6	Superior
Product life cycle	Late	0	1	2	3	(4)	5	6	Early
Product replacement cycle	Variable	0	1	2	3	(4)	5	6	Fixed
Customer loyalty	Low	0	1	2	3	(4)	5	6	High
Competition's capacity utilization	Low	0	1	2	(3)	4	5	6	High
Technological know-how	Low	0	1	2	3	4	5	(6)	High
Vertical integration	Low	0	1	2	(3)	4	5	6	High

Average – 6 = $\underline{33 \div 8 - 6 =}$ – 1.87

McDonnell-Douglas

Company Assessment

Factors determining competitive advantage									
Market share	Small	0	(1)	2	3	4	5	6	Large
Product quality	Inferior	0	1	2	(3)	4	5	6	Superior
Product life cycle	Late	0	1	(2)	3	4	5	6	Early
Product replacement cycle	Variable	0	1	2	3	(4)	5	6	Fixed
Customer loyalty	Low	0	(1)	2	3	4	5	6	High
Competition's capacity utilization	Low	0	(1)	2	3	4	5	6	High
Technological know-how	Low	0	1	2	(3)	4	5	6	High
Vertical integration	Low	0	1	(2)	3	4	5	6	High

Average − 6 = $\underline{17 \div 8 - 6 =}$ -3.87

Airbus Industrie

Company Assessment

Factors determining financial strength

Return on investment	Low	0	(1)	2	3	4	5	6	High
Leverage	Imbalanced	0	1	2	3	4	5	(6)	Balanced
Liquidity	Imbalanced	0	1	2	3	4	5	(6)	Balanced
Capital required/capital available	High	0	1	2	3	4	(5)	6	Low
Cash flow	Low	0	1	2	3	4	(5)	6	High
Ease of exit from market	Difficult	0	1	2	(3)	4	5	6	Easy
Risk involved in business	Much	0	1	2	(3)	4	5	6	Little

Average 29 ÷ 7 = 4.1

Boeing

Company Assessment

Factors determining financial strength

Return on investment	Low	0	1	2	3	(4)	5	6	High
Leverage	Imbalanced	0	1	2	3	(4)	5	6	Balanced
Liquidity	Imbalanced	0	1	2	3	(4)	5	6	Balanced
Capital required/capital available	High	0	1	2	3	4	(5)	6	Low
Cash flow	Low	0	1	2	3	(4)	5	6	High
Ease of exit from market	Difficult	0	(1)	2	3	4	5	6	Easy
Risk involved in business	Much	0	1	2	3	4	(5)	6	Little

Average $27 \div 7 = 3.9$

McDonnell-Douglas

Company Assessment

Factors determining financial strength

Return on investment	Low	0	1	(2)	3	4	5	6	High
Leverage	Imbalanced	0	1	(2)	3	4	5	6	Balanced
Liquidity	Imbalanced	0	1	(2)	3	4	5	6	Balanced
Capital required/capital available	High	0	(1)	2	3	4	5	6	Low
Cash flow	Low	0	1	(2)	3	4	5	6	High
Ease of exit from market	Difficult	0	1	2	3	4	(5)	6	Easy
Risk involved in business	Much	0	(1)	2	3	4	5	6	Little

Average $15 \div 7 = 2.1$